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The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

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The present volume is the eighty-first of this series.

The series of *Bulletins*, the first of which was issued in 1875, contains separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogues of type specimens and special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution.

WASHINGTON, D. C., *February 3, 1933.*

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By A S Pearse

NEW BOPYRID ISOPOD CRUSTACEANS FROM DRY TORTUGAS FLORIDA

BY

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NEW BOPYRID ISOPOD CRUSTACEANS FROM DRY TORTUGAS, FLORIDA

By A. S. Pearse

Department of Zoology, Duke University, Durham, N. C.

During the summer of 1931 two new species of bopyrids and an undescribed male of one of Harriet Richardson's species were found at Dry Tortugas, Fla. These are herewith described.

BOPYRO, new genus

Description.—Bopyridae: In the female the first four segments of the abdomen are distinct and the last two partly fused. There are no uropods and only four pairs of pleopods, which are more or less cylindrical. The distal segment of the first lamella of the marsupium is produced into a blunt, conical lobe.

In the male the first three segments of the abdomen are distinct, and the last three are fused into a trilobate terminal piece. There are no uropods, and pleopods are absent or rudimentary.

The genus differs from *Probopyrus* in having free abdominal segments in the male and fused abdominal segments in the female; from *Bopyriscus* in having uniramous pleopods in the female; and from *Bopyrina* in having distinct abdominal segments in the male.

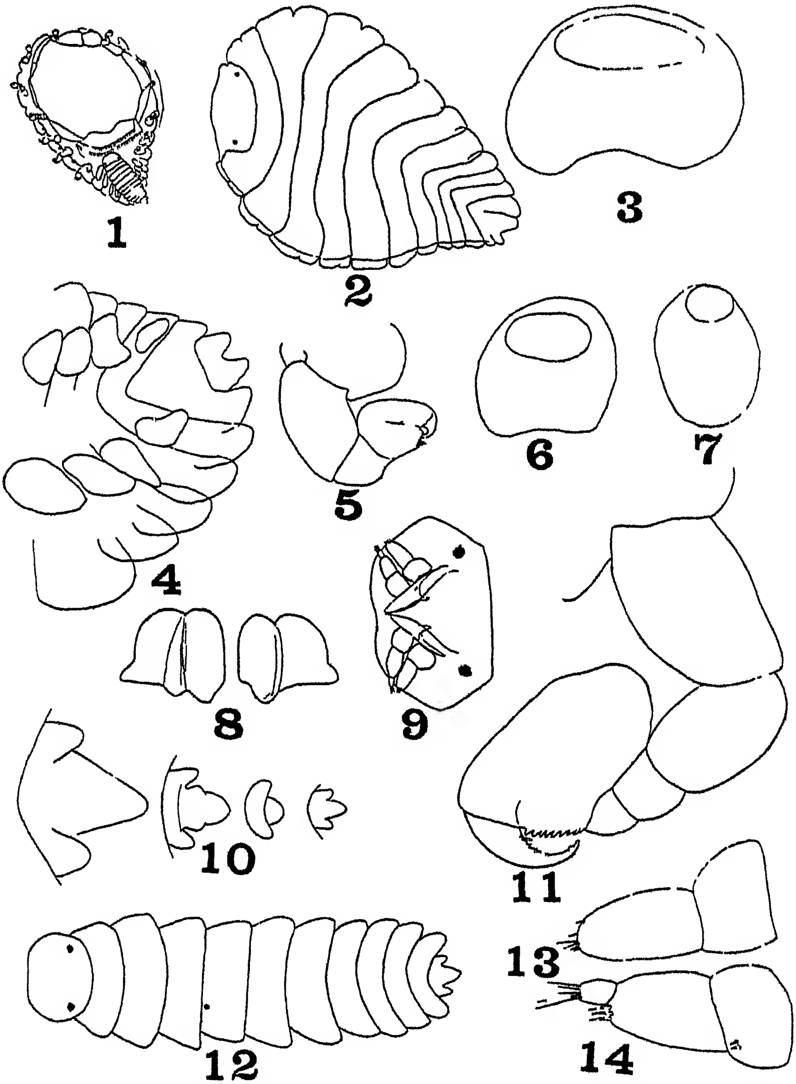
BOPYRO CHOPRAE, new species

Figures 1–14

This isopod is a parasite in the branchial cavity of *Synalpheus brooksi* Coutiere, which lives in the loggerhead sponge, *Speciospongia vespara* (Lamarck) Marshall, at Tortugas, Fla.

Description.—Female: Body, asymmetrical, one side longer than the other; longer than wide, 6.2 mm. by 4.3 mm. Head deeply set in thorax, twice as wide as long, produced into an obtuse process at the anterior angle, with front slightly elevated near middle. Eyes placed near the lateral margins of the head, small, irregular. First antennae small, 3-segmented. Second antennae shorter than first, 2-segmented. The seven thoracic segments are distinct. The lateral margins of first four are bilobate. All bear lamellar epimeral plates along one margin. Seven pairs of subchelate peraeo-

pods are present. Ovarian bosses make the plates above the brood pouch reticulate. The first four segments of the abdomen are distinct; the last two are not completely separated. There are no

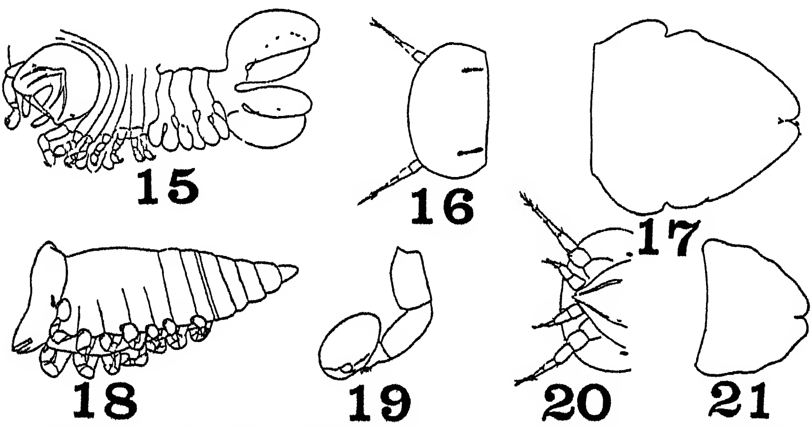


FIGURES 1–14.—*Bopyro choprae,* new species: 1, Male and female; 2, female, dorsal view; 3, first pleopod, female; 4, abdomen of female, ventral view; 5, seventh peraeopod, female; 6, 7, third and fourth pleopods, female; 8, first incubatory lamellae, female; 9, ventral view of head, male; 10, posterior ends of abdomen, male; 11, first peraeopod, male; 12, body of male, dorsal view; 13, second antenna, male; 14, first antenna, male

uropoda. Four pairs of more or less cylindrical pleopods are present; those of the first two are slightly bilobed at the tip; those of the two posterior pairs are cylindrical and rounded distally. The five

pairs of incubatory lamellae do not completely inclose the brood pouch. The first pair are produced into a blunt lobe distally. The posterior pair are setose along their distal margins.

Male: Length of body, 1.2 mm.; width, 0.4 mm.; slightly concave at the middle. First antennae 3-segmented, second antennae 2-segmented. Eyes near posterolateral angles, rounded. There are seven distinct thoracic metameres and seven pairs of subchelate peraeopods. The first three segments of the abdomen are distinct; the last three are fused into a tail piece, which bears three rounded, distal lobes, the median one of which is much larger and projects much beyond the others. Epimeral plates are larger on the right than on the left later margins. There are no uropoda, and pleopods



FIGURES 15–21.—*Hemiarthrus schmitti*, new species: 15, Female, without incubatory pouch; 16, head of male, dorsal view; 17, male abdomen; 18, young female; 19, first leg, male; 20, head of male, ventral view; 21, male abdomen

are represented only by two pairs of tubercles on the first two abdominal segments.

The species is named for Dr. B. C. Chopra, of the Indian Museum.

Type.—U.S.N.M. No. 64488.

Genus HEMIARTHRUS Giard and Bonnier

HEMIARTHRUS SCHMITTI, new species

FIGURES 15–21

This isopod is a parasite on the ventral side of the abdomen of *Synalpheus brooksi* Coutiere at Tortugas, Fla. The host lives in the loggerhead sponge, *Speciospongia vespara* (Lamarck) Marshall.

Description.—Female: Body asymmetrical, greatly swollen on one side by outgrowth of marsupial pouch; length of largest specimen, 4.6 mm.; width, 2.5 mm. Head flat, somewhat wider than long, deeply sunk into thorax; anterior margin nearly straight; a blunt lobe at the anterolateral angle on the side opposite the marsupial pouch.

Antennae digitiform. Eyes somewhat elongated, near lateral margins of head, nearer anterior than posterior margin. A forked chitinous thickening branches above the mouth and bifurcates on each cheek. Seven thoracic segments and seven legs are apparent on the side of the body opposite the marsupium; the other side bears only the first leg, and the somites are not defined. The thoracic legs are all subchelate. Ovarian bosses are present on the marsupial side of the thorax. The abdomen is composed of four segments. On the side away from the marsupium the first three segments each bear an appendage, which ends in two flat, spatulate rami; the last somite bears two such appendages; in other words, there is a fringe of five flattened, biramous appendages along the lateral and posterior border of the abdomen. There are five pairs of incubatory lamellae, which inclose a more or less spherical mass of eggs; those on the side of the body without legs are very small.

Three young females were found attached to the abdomens of alpheids among the swimmerets. These measured 0.7, 1.1, and 1.3 mm. in length, respectively. They (fig. 18) have seven pairs of subchelate legs on the thorax, and a tapering, 6-segmented abdomen, which is without appendages. The first segment of the abdomen is much shorter than those following. The head is flat and resembles that of the adult.

Male: Narrow, 1.8 mm. long, 0.5 mm. wide. Head rounded anteriorly, straight across the posterior margin. Eyes elongated, near posterolateral angles. Antennae tapering, first pair less than half as long as second, 3-segmented; second pair 7-segmented. Thorax 7-segmented, with seven pairs of subchelate appendages. Abdomen unsegmented, without appendages; lateral margins somewhat variable, often with a deep notch near the base and another slight indentation nearer the tip; posterior end, always rounded and emarginate.

The species is named for Dr. Waldo Schmitt, curator of marine invertebrates, United States National Museum.

Type.—U.S.N.M. No. 65147.

Genus STEGIAS Richardson

STEGIAS CLIBANARII Richardson

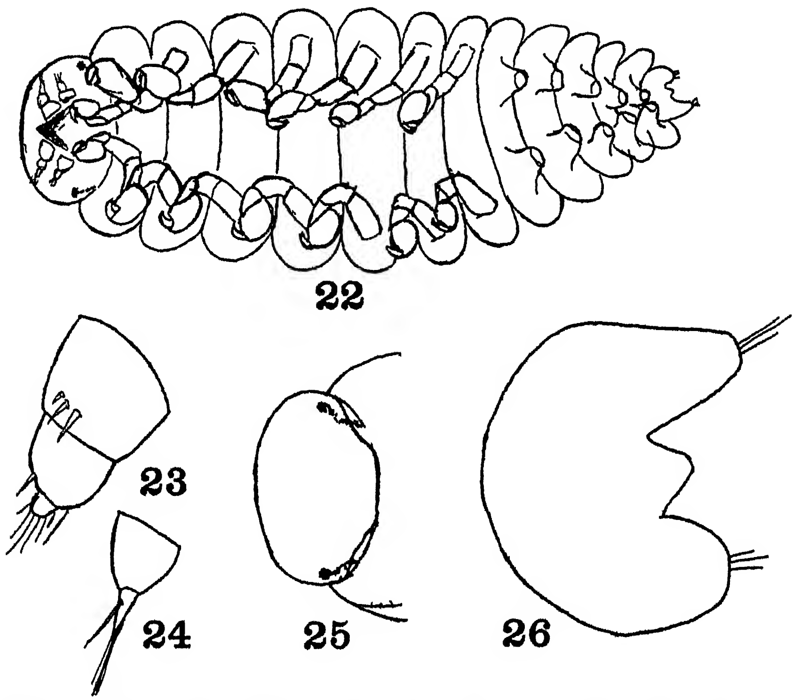
FIGURES 22–26

Stegias clibanarii RICHARDSON, Proc. U. S. Nat Mus, vol. 27, pp. 59–60, 1904.

Through the kindness of Prof. B. W. Kunkel, three specimens of this species, all now in the United States National Museum, were obtained from the branchial cavity of *Clibanarius tricolor* (Gibbes). The two females differ in some respects from Richardson's description, which was made from one very old specimen, but the abdomens and their appendages agree quite well with her descrip-

tion. The females measure 2.5 and 3.1 mm. long and 1.2 and 1.7 mm. wide. They are more asymmetrical than Richardson's figures show, and their bodies are bent somewhat more to one side; the fourth and fifth pairs of legs are not widely separated. As Richardson had no male specimens, the following description of the male is given:

Body 0.9 mm. long, 0.2 mm. wide, straight except for the abdomen, which is bent slightly toward the left side; consists of a head and 13 free segments. Head rounded along lateral and anterior margins, wider than long, inclosed for a third of its length in the first thoracic segment. Eyes near posterolateral margins of the head, small;



FIGURES 22–26.—*Stegias clibanarii* Richardson, male. 22, Ventral view; 23, first antenna; 24, second antenna; 25, head, dorsal view; 26, tip of abdomen, ventral view.

there are circular spots continuous posteriorly with pigmented sinuous bands, which reach to the posterior margin of the head. First antennae 3-segmented, second antennae 2-segmented. Thorax composed of seven free segments, each of which bears a pair of subchelate pereiopods; first pair of pereiopods smaller than the remaining pairs. Abdomen 6-segmented; first five segments each bear a pair of conical ventral appendages. Sixth segment terminating in two lateral and a smaller median conical process; asymmetrical, the right process being longer than the left.

Types.—Female, in the Peabody Museum, Yale University; male, U.S.N.M. No. 65146.

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BIRDS COLLECTED IN CUBA AND HAITI BY THE PARISH-SMITHSONIAN EXPEDITION OF 1930

BY

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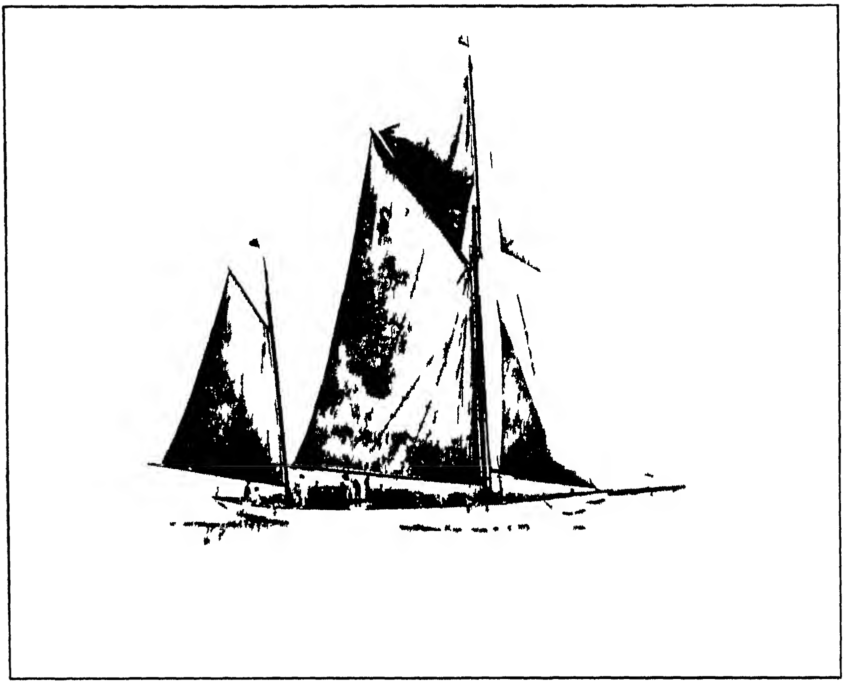
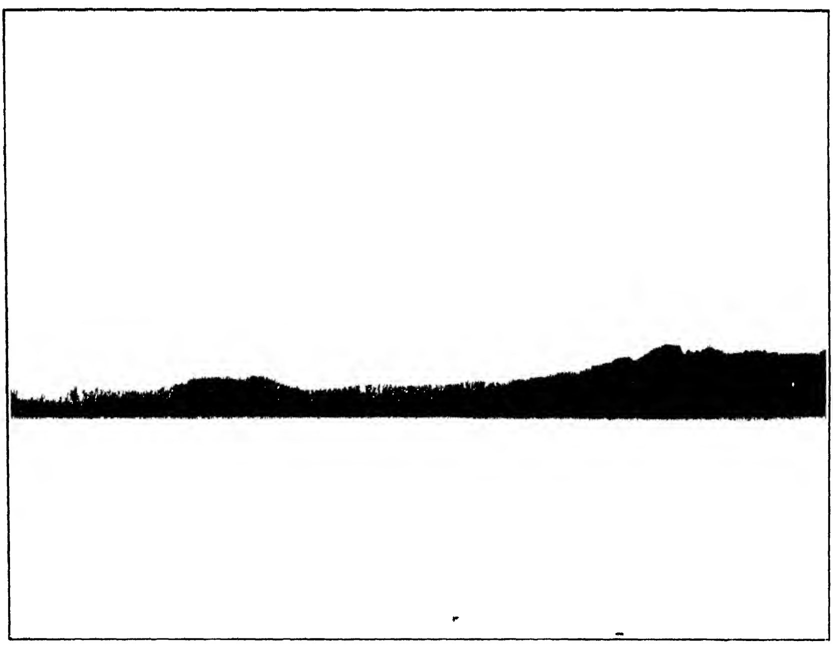


THE ESPERANZA UNDER SAIL



PORT TANAMO CUBA FROM THE SEA

BIRDS COLLECTED IN CUBA AND HAITI BY THE PARISH-SMITHSONIAN EXPEDITION OF 1930

By Alexander Wetmore
Assistant Secretary, Smithsonian Institution

INTRODUCTION

The Parish-Smithsonian Expedition of 1930 was organized by the late Lee H. Parish, with the cooperation of his father, Semmes W. Parish, for zoological exploration in Haiti, including also in its scope studies along the northern coast of Cuba. Though planned principally to cover work with birds and reptiles, so far as practicable the investigations included also collections of mammals, fishes, mollusks, and other groups. The present report is concerned with the birds, of which 558 specimens and six sets of eggs were obtained.

The party had at its service the yacht *Esperanza* (pl. 1), an 80-foot ketch-rigged boat equipped with an auxiliary engine, so that it was practicable to work at a number of important areas, particularly in Haiti, that otherwise would have been difficult of access.

Besides the two already mentioned, the party included Mrs. S. W. Parish, who assisted in radio communication, in photography, and in the care of specimens, and Watson M. Perrygo, of the staff of taxidermists of the United States National Museum. In addition to being head of the scientific party Lee Parish was captain and navigator, and was untiring in his efforts to promote the success of the work. The party devoted the major part of its time to collections on islands lying off the Haitian coast, as the *Esperanza* offered an exceptional opportunity for study in these comparatively little-worked areas.

The *Esperanza* left Miami, Fla., in the afternoon of February 15, 1930. The following morning a black-throated blue warbler and two Maryland yellowthroats came aboard, and the first specimen of the expedition, a yellowthroat, was obtained. On the same day the ship passed Bimini and that night anchored at Gun Cay in the Bahamas, but no landing could be made because of stormy weather. After a stormy passage the ship anchored at Gibara, Cuba, on February 20, and remained there until February 28, allowing oppor-

tunity for collections along the shore 3 miles east, on Santa Rosalia Lagoon, and on the Río Gibara above its mouth. On February 26, the naturalists visited a cave approximately a mile south of the town.

On March 1 the *Esperanza* anchored in the bay of Tánamo (pl. 1), where collections were made on the two following days south of town and on Turones Cay. On March 4, the party stopped to collect at Cayo Grande de Moa, and near the mouths of the Moa and Fabrico Rivers (pl. 2), where conditions were so interesting that they remained until March 9. They arrived at Baracoa (pl. 2) on the 9th and remained there until March 11, and then continued through the Windward Passage, arriving in Port au Prince on March 13.

The party obtained necessary permits to allow scientific collecting in Haiti through the kind offices of Gen. J. H. Russell, who at that time was American High Commissioner, and of others, and on March 19 they sailed for Gonave Island, accompanied by Colonel and Mrs. Coyle and Lieut. Faustin Wirkus. That afternoon they landed on Petite Gonave Island, where a number of iguanas and various birds were obtained. (Pl. 3.) This island is of low elevation and has an area of approximately 15 acres, the surface being mainly a sharply eroded limestone with a mangrove swamp at the center. On March 20 the *Esperanza* anchored near the lighthouse at the western end of Gonave Island, a point where important collections were made, as little or no work had been done in this remote section. On March 21 they moved to Anse à Galets and the following day made a trip into the interior of Gonave to a region known as Palma. (Pl. 3.) They returned on the 23d to Port au Prince to obtain supplies for a voyage along the southwestern peninsula. While here collections were made on March 26, 27, and 28 at Montet, and on March 31 an area southwest of Port au Prince was visited. On April 1 Lee Parish collected near Thomazeau.

On April 4 the *Esperanza* sailed to the westward arriving in the Bay of Baradères the following day (pl. 4). On April 6 the party visited two caves near a point called Mapou to explore for bones of extinct mammals. The first cave entered was small and, though so dry that conditions were favorable, produced no bones. A barn owl was taken and some human remains were found on a shelf. The second cave was deep, with water seeping through the ceiling, making it too damp for bones to have been preserved. Many birds were observed in the area adjacent. Further collections were made on the peninsula near Grand-Boucan on April 7, and on April 9, under guidance of the chief of the section, an expedition on horseback was made up the fertile valley of Petit Trou de Nippes to a cave con-

taining a large pool of clear water. The first chamber of this cavern was dry but contained no bones, while the inner chambers were damp. On April 10 and 11 collections were made near the mouth of the Baradères River. (Pl. 4.)

About dark on April 11 the *Esperanza* anchored off Grande Cayemite Island, rather large in area, rough and rocky, with broad areas covered with "Madame Michel" grass. The ship remained there until the following day and then moved to Petite Cayemite Island, which resembles the larger adjacent island in being of roughly eroded limestone. Work continued there until April 18, when Mr. and Mrs. Parish crossed to Corail for supplies, stopping on the way to collect at Bug Island, where they obtained numerous birds. (Pl. 5.)

On April 21 the party anchored in Bigie Bay (Pl. 5) at the extreme western end of the southwestern peninsula, and remained there, because of rough seas, until April 24, to collect in that vicinity and to recuperate from attacks of fever. On April 26 they came to Aux Cayes for supplies, and the following day crossed to Ile à Vache, dropping anchor in the beautiful little land-locked harbor of Feret Bay. (Pl. 6.) This bay, at the western end of the island, is lined by sandy beaches behind which grow coconut, cashew, and mango trees. From a boat, carried across into a salt-water lagoon in the interior, crocodiles and many other reptiles were collected. As the island had been unknown zoologically, all collections were important, and the party remained there until May 8. Collections were made throughout the higher ground of the western part of the island, and also on Raquette Cay, a small island off the eastern headland of Feret Bay, a haunt of pelicans and frigate birds. Among the reptiles taken at Île à Vache were a number of living specimens for the National Zoological Park. On May 6 a trip was made into the swampy region in the eastern part of the island.

Going by way of Bigie Bay, the *Esperanza* anchored at daybreak on May 10 in Lulu Bay at Navassa Island. (Pl. 7.) Landing was made by means of a steel ladder, which allowed ascent of the 20-foot cliff that bounds the lower level of the island. The island, uninhabited by man, was covered with low trees and thorny bushes growing over a rough, eroded limestone with little soil. Because of weather conditions the shore party had to return to the ship at 10 a. m., but they covered a good part of the island and obtained a representative set of the birds and a few reptiles. With no shelter from the blazing sun, heat was so intense that the collectors returned to the ship nearly exhausted. High seas prevented further work planned at the western end of Gonave Island, and the boat continued along the south coast of Gonave, anchoring on May 13 at Petite Gon-

ave Island. The following day a number of live iguanas were obtained for the National Zoological Park, and studies were made that might be used subsequently in preparing a habitat group of these interesting animals. The native fishermen were much afraid of these great lizards, but said that they were easily captured by putting rum in hollows in the rocks, where the iguanas would drink it and become helpless. The six obtained were taken by hand, the dangerous attributes of these animals being entirely imaginary. That evening the party sailed for Port au Prince. Miscellaneous collecting continued in that vicinity until the *Esperanza* set sail for Miami on May 24, and Mr. Perrygo left for New York on the steamship Ancon on May 28.

The expedition was highly successful in its objective of making collections on remote islands, and the specimens obtained, particularly the series of birds and reptiles, form valuable additions to the Haitian collections of the United States National Museum.

The success of the work was due largely to the initiative of Lee H. Parish, who was responsible for the organization of the party and whose skill as a navigator and resourcefulness under the difficult conditions of travel in waters remote from ordinary facilities made possible the scientific investigation of a number of little-known localities. Mr. Parish, in addition to these responsible duties, assisted constantly in the zoological work, both in collecting and in the preparation of specimens.

DISCUSSION OF THE AVIFAUNA

The collection from Haiti included skins of the black-throated green warbler (*Dendroica virens virens*) and the black-whiskered vireo (*Vireo olivaceus barbatula*) as first records for Hispaniola. In addition there were two forms new to science, the Navassa ground dove (*Columbigallina passerina navassae*) and the Île à Vache bullfinch (*Loxigilla violacea parishi*). With these the total list of birds known for Hispaniola is increased to 219.

Great interest attaches to the forms of birds that occur on the offlying islands, as it frequently happens that common species on the larger land mass do not occur on its small dependencies. As indicated in the introductory statement of this report, the present expedition made special attempt to collect on small offshore islands, and it met with good success in these efforts. The birds recorded from certain of the islands will now be considered in more detail.

GONAVE ISLAND

The bird life of Gonave Island has been carefully studied by Dr. W. L. Abbott, with later collections from visits by A. J. Poole and W. M. Perrygo, traveling for the National Museum, so that Wetmore

Above the Mouth of the Rio Moa Cuba

Near Baracoa Cuba

GONAVE ISLAND, INLAND FROM ANSE À GALETS

THE SHORE LINE OF PETITE GONAVE ISLAND

Native fishermen in foreground.

and Swales [1] have listed 84 forms from that island on the basis of the collections mentioned. The Parish expedition obtained in addition the tropic-bird (*Phaëthon lepturus catesbyi*) and the black-whiskered vireo (*Vireo olivaceus barbatula*), which raise the total to 86. The tropic-bird is a nesting species, and the vireo is a migrant that nests in southern Florida, the Bahamas, and Cuba.

NAVASSA ISLAND

The specimens secured on Navassa Island established the subspecific distinctness of the Navassa ground dove, described from skins collected by the present expedition as *Columbigallina passerina navassae* (Wetmore). Other species obtained have been listed [2] previously, though it is interesting to call attention to the collection of another skin of the ani (*Crotophaga ani*) from Navassa, further evidence that this cuckoo is a regular resident on the island.

PETITE GONAVE ISLAND

The island of Petite Gonave at the eastern end of Gonave Island has an area of approximately 15 acres, most of which is a very sharply eroded limestone formation, with a mangrove swamp in the center. The island is the home of a few fishermen and is remarkable especially for the occurrence of iguanas that range there in abundance. Several of these were captured alive for the National Zoological Park.

As would be expected, relatively few species of birds were obtained during a few hours' collecting, the total list numbering only 10. The golden warbler is one of considerable interest, since it is the same form as that found on Gonave Island and differs from that of the main island. The occurrence of the clapper rail is of interest as it is of decidedly local occurrence in this region. Following is the complete list to date, which will be extended principally through the occurrence of migrants, though there are several other resident forms that should occur:

Louisiana heron	*Hydranassa tricolor ruficollis.*
Little blue heron	*Florida caerulea caerulescens.*
West Indian green heron	*Butorides virescens maculatus.*
Hispaniolan clapper rail	*Rallus longirostris vafer.*
Semipalmated plover	*Charadrius semipalmatus.*
Lesser yellowlegs	*Totanus flavipes.*
Eastern white-winged dove	*Melopelia asiatica asiatica.*
Gray kingbird	*Tyrannus dominicensis dominicensis.*
Gonave golden warbler	*Dendroica petechia solaris.*
Northern water-thrush	*Seiurus noveboracensis noveboracensis*

[1] U. S. Nat. Mus. Bull. 155, 1931, pp. 47–48.
[2] Idem, p. 53.

GRANDE CAYEMITE ISLAND

The island of Grande Cayemite, located near the center of the northern shore of the southwestern peninsula of Haiti, is nearly 9 kilometers long by 5 kilometers broad, and rises to an elevation of about 152 meters. It is rough and rocky with considerable area of scrub and many patches of "Madame Michel" grass. The avifauna of this island has been known previously from the work of Dr. W. L. Abbott, who recorded there 13 forms of birds from January 4 to 14, 1918. The Parish party increased this number by 12, so that it will be of interest to give the entire list as at present constituted. The presence of Ridgway's hawk, the golden warbler (the same form that inhabits adjacent Haiti), and the clapper rail is of interest. Several species recorded on the adjacent island of Petite Cayemite will undoubtedly be found here also. Following is the list of forms:

West Indian brown pelican	*Pelecanus occidentalis occidentalis.*
Snowy heron	*Leucophoyx thula thula.*
Louisiana heron	*Hydranassa tricolor ruficollis.*
West Indian green heron	*Butorides virescens maculatus.*
Yellow-crowned night heron	*Nyctanassa violacea violacea.*
Ridgway's hawk	*Buteo ridgwayi.*
Hispaniolan clapper rail	*Rallus longirostris vafer.*
Rufous-naped plover	*Pagolla wilsonia rufinucha.*
Lesser yellowlegs	*Totanus flavipes.*
Least sandpiper	*Pisobia minutilla.*
Black-necked stilt	*Himantopus mexicanus.*
White-crowned pigeon	*Columba leucocephala.*
Zenaida dove	*Zenaida zenaida zenaida.*
Hispaniolan parrot	*Amazona ventralis.*
Ani	*Crotophaga ani.*
Gray kingbird	*Tyrannus dominicensis dominicensis.*
Hispaniolan flycatcher	*Myiarchus dominicensis.*
Jamaican vireo	*Vireo olivaceus olivaceus.*
Hispaniolan golden warbler	*Dendroica petechia albicollis.*
Myrtle warbler	*Dendroica coronata coronata.*
Black-throated blue warbler	*Dendroica caerulescens caerulescens.*
Palm warbler	*Dendroica palmarum palmarum.*
Northern prairie warbler	*Dendroica discolor discolor.*
Grinnell's water-thrush	*Seiurus noveboracensis notabilis.*
Yellow-faced grassquit	*Tiaris olivacea olivacea.*

PETITE CAYEMITE ISLAND

The island of Petite Cayemite, located a little more than a kilometer west of Grande Cayemite Island, is about 3 kilometers long by 2 kilometers broad. The surface is of roughly eroded limestone covered with dense growths of "Madame Michel" grass and with some scrub, through which travel is difficult as there are few trails. The only previous visit of a naturalist recorded is that of Dr. W. L.

Abbott, who went there for a few hours on January 13, 1918. The naturalists of the Parish expedition collected 20 species of birds, and one form not obtained by them was secured by Doctor Abbott, making the known list 21. There will be various additions as further work is done. Following is the complete list as known at present:

Little blue heron	*Florida caerulea caerulescens.*
Yellow-crowned night heron	*Nyctanassa violacea violacea.*
West Indian red-tailed hawk	*Buteo jamaicensis jamaicensis.*
Ridgway's hawk	*Buteo ridgwayi.*
Hispaniolan sparrow hawk	*Falco sparverius dominicensis.*
Black-necked stilt	*Himantopus mexicanus.*
White-crowned pigeon	*Columba leucocephala.*
Cuban ground dove	*Columbigallina passerina insularis.*
Key West quail-dove	*Oreopeleia chrysia.*
Hispaniolan vervain hummingbird	*Mellisuga minima vielloti.*
Hispaniolan mango hummingbird	*Anthracothorax dominicus.*
Gray kingbird	*Tyrannus dominicensis dominicensis.*
Hispaniolan flycatcher	*Myiarchus dominicensis.*
Hispaniolan mockingbird	*Mimus polyglottos dominicus.*
Jamaican vireo	*Vireo olivaceus olivaceus.*
Hispaniolan honey-creeper	*Coereba bananivora bananivora.*
Hispaniolan golden warbler	*Dendroica petechia albicollis.*
Cape May warbler	*Dendroica tigrina.*
Ovenbird	*Seiurus aurocapillus aurocapillus.*
Redstart	*Setophaga ruticilla.*
Yellow-faced grassquit	*Tiaris olivacea olivacea.*

ÎLE À VACHE

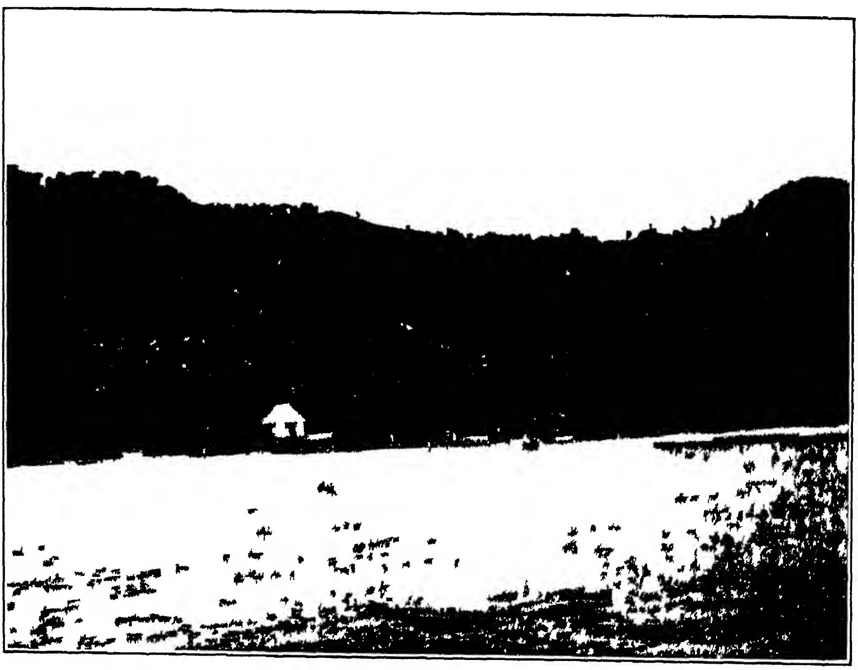
Île à Vache lies off the southern coast of the southwestern peninsula of Haiti, opposite the town of Aux Cayes, and is between 10 and 12 kilometers distant from the main shore. The island is about 12 kilometers long by 5 or a little more wide. The western end is elevated and rolling with many indentations along its shore line, while the eastern section is low and swampy. The island supports a number of families, but has tracts of brush and scrub, and birds are common. The *Esperanza* was anchored in Feret Bay, which was made the headquarters for work that covered the greater part of the island. So far as known no other naturalists have worked there, so that especial attention was given to obtaining collections as complete as possible. The bird list included 37 species, of which the bullfinch, which has been described as *Loxigilla violacea parishi*, proved new. A noteworthy species is Ridgway's hawk, of rare occurrence in most localities. The island seems an especially favorable point for the study of spring migration from the specimens obtained. The black-throated green warbler, obtained here by the Parish Expedition, is the first record for Haiti, and other species were recorded at rather late dates. Following is the complete list of species:

Antillean grebe	*Podilymbus podiceps antillarum.*
West Indian brown pelican	*Pelecanus occidentalis occidentalis.*
Frigate-bird	*Fregata magnificens.*
Louisiana heron	*Hydranassa tricolor ruficollis.*
Little blue heron	*Florida caerulea caerulescens.*
West Indian green heron	*Butorides virescens maculatus.*
Yellow-crowned night heron	*Nyctanassa violacea violacea.*
West Indian tree-duck	*Dendrocygna arborea.*
Ridgway's hawk	*Buteo ridgwayi.*
Hispaniolan sparrow hawk	*Falco sparverius dominicensis.*
Antillean gallinule	*Gallinula chloropus portoricensis.*
Spotted sandpiper	*Actitis macularia.*
Black-necked stilt	*Himantopus mexicanus.*
White-crowned pigeon	*Columba leucocephala.*
White-winged dove	*Melopelia asiatica asiatica.*
Cuban ground dove	*Columbigallina passerina insularis.*
Mangrove cuckoo	*Coccyzus minor teres.*
Ani	*Crotophaga ani.*
Hispaniolan mango hummingbird	*Anthracothorax dominicus.*
Gray kingbird	*Tyrannus dominicensis dominicensis.*
Hispaniolan flycatcher	*Myiarchus dominicensis.*
Bank swallow	*Riparia riparia riparia.*
Hispaniolan cliff swallow	*Petrochelidon fulva fulva.*
Hispaniolan mockingbird	*Mimus polyglottos dominicus.*
Jamaican vireo	*Vireo olivaceus olivaceus.*
Black-whiskered vireo	*Vireo olivaceus barbatula.*
Hispaniolan honey-creeper	*Coereba bananivora bananivora.*
Black and white warbler	*Mniotilta varia.*
Black-throated green warbler	*Dendroica virens virens.*
Northern prairie warbler	*Dendroica discolor discolor.*
Black-poll warbler	*Dendroica striata.*
Northern water-thrush	*Seiurus noveboracensis noveboracensis.*
Hispaniolan grackle	*Holoquiscalus niger niger.*
Île à Vache palm tanager	*Phaenicophilus poliocephalus tetraopes.*
Yellow-faced grassquit	*Tiaris olivacea olivacea.*
March's grassquit	*Tiaris bicolor marchii.*
Parish's bullfinch	*Loxigilla violacea parishi.*

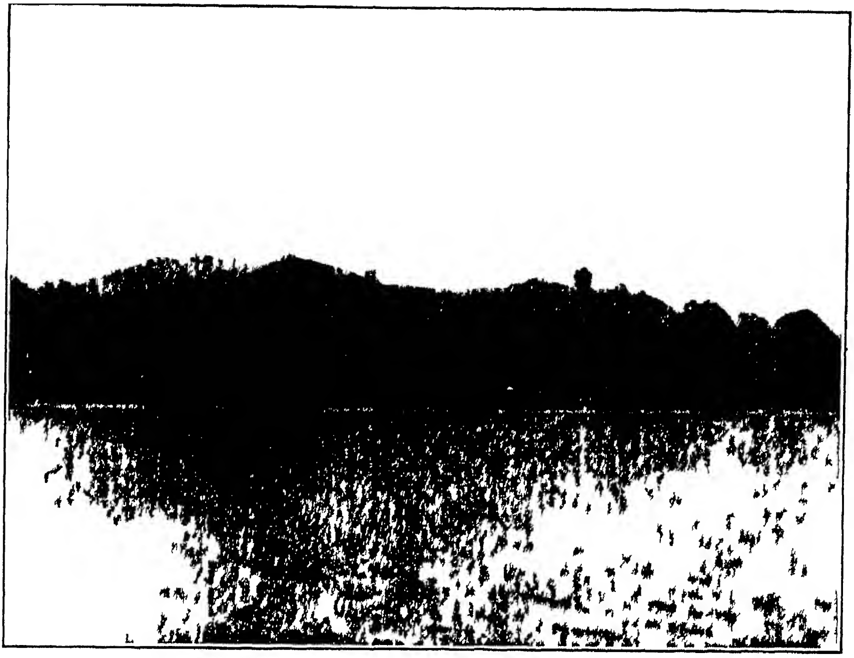
NEAR THE MOUTH OF THE BARADFRES RIVER HAITI

SHORE LINE NEAR PETIT TROU DE NIPPES HAITI

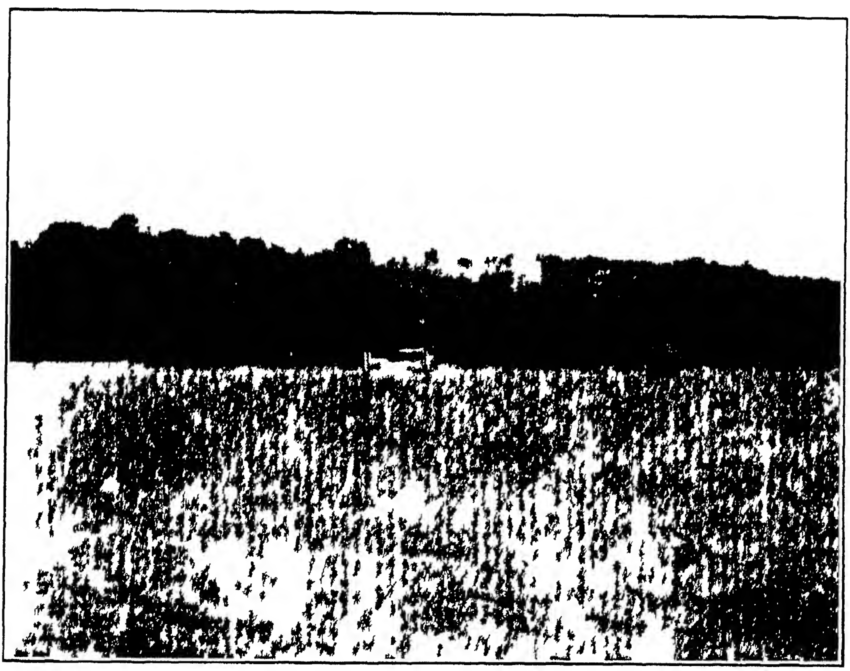
TOWN OF CORAIL HAITI
The Cayemite Islands in the distance



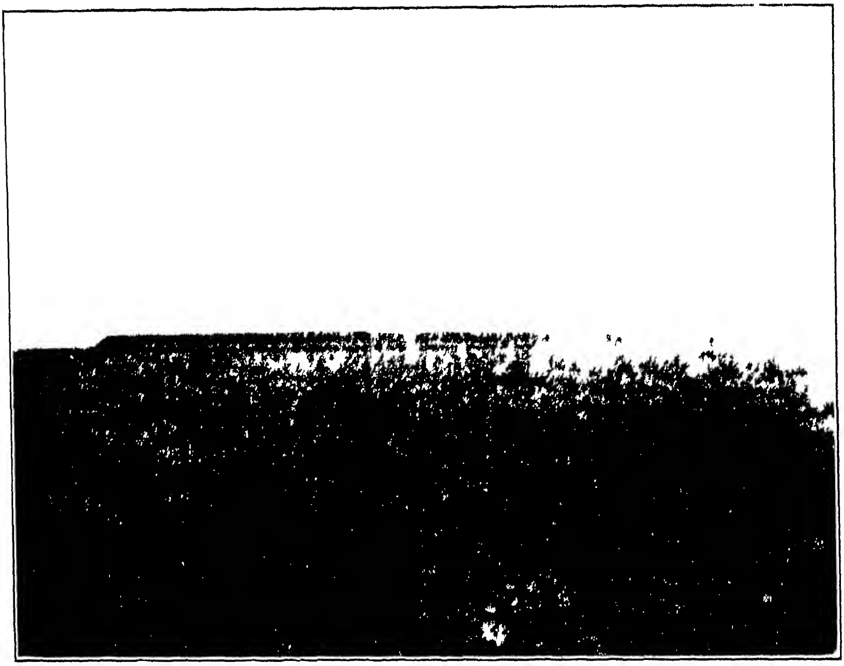
BIGIE BAY HAITI



FERET BAY ILE A VACHE HAITI



FERET BAY ILE A VACHE HAITI



Navassa Island

Shore Line of Navassa Island Showing Undercut Boundary Cliff

Order COLYMBIFORMES

Family COLYMBIDAE, Grebes

PODILYMBUS PODICEPS ANTILLARUM Bangs

ANTILLEAN GREBE

Podilymbus podiceps antillarum BANGS, Proc. New England Zoöl. Club, vol. 4, Mar. 31, 1913, p. 89 (Bueycito, Province of Oriente, Cuba).

W. M. Perrygo obtained an adult female and a young bird only a few days old on a small stream near Montet on March 27. The chick does not differ appreciably from the young of *P. p. podiceps* of the United States. Two other chicks, taken on Île à Vache on May 3, were preserved in alcohol.

Order PELECANIFORMES

Suborder PHAËTHONTES

Family PHAËTHONTIDAE, Tropic-birds

PHAËTHON LEPTURUS CATESBYI Brandt

YELLOW-BILLED TROPIC-BIRD

Phaëthon Catesbyi BRANDT, Bull. Sci. l'Acad. Imp. Sci. St. Pétersbourg, vol. 4, May 10, 1838, p. 98 (Bermuda).

On March 21, 1930, eight pairs of tropic-birds were found along cliffs at the western end of Gonave Island, where they appeared to be nesting. A pair was collected by S. W. Parish. The bird has not been recorded here previously.

Suborder PELECANI

Family PELECANIDAE, Pelicans

PELECANUS OCCIDENTALIS OCCIDENTALIS Linnaeus

WEST INDIAN BROWN PELICAN

Pelecanus Onocrotalus β occidentalis LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 215 (Jamaica).

A male pelican, an immature bird with a mixture of gray on the crown, was collected by S. W. Parish at Grand-Boucan on Baradères Bay, April 11, 1930. This bird with a wing measurement of

465 mm is of the typical West Indian race. Others were recorded at Anse à Galets on Gonave Island, March 22, and at Île à Vache April 28. At the latter locality a female was prepared as a skeleton on May 5.

PELECANUS OCCIDENTALIS CAROLINENSIS Gmelin

NORTHERN BROWN PELICAN

Pelecanus carolinensis GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 571 (Charleston Harbor, S. C.).

A female, secured on March 7 at Cayo Grande de Moa, is an adult bird in postbreeding plumage. This specimen has a wing measurement of 495 mm and is a representative of the northern race found along the coasts of the Southeastern United States, which is distinguished from the West Indian bird by larger size. It seems probable that the Moa specimen comes from the north as a wanderer, but its capture suggests the possibility that the resident pelican of the northern coast of Cuba may not be the typical West Indian form, but instead may be the same as the breeding bird of Florida. The writer and Dr. Robert Cushman Murphy arrived independently at belief in the distinctness of this form, which has been recognized also by J. L. Peters.[3]

The name here used seems to be the earliest that has been applied to the brown pelican of the United States. *Pelecanus albicollis* C. J. Maynard, described[4] from Cedar Keys, Fla., is a synonym.

Family SULIDAE, Gannets and Boobies

SULA PISCATOR (Linnaeus)

RED-FOOTED BOOBY

Pelecanus Piscator LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 134 (Java Sea).

Six specimens of this booby were taken from the hundreds seen on Navassa Island on May 10, 1930. The skins prepared include one young bird in downy plumage with wing and tail feathers partly grown. Two of the specimens are in gray plumage with white tails, and one is in full adult white dress. The breeding colony here appears to be extensive, as the collectors speak of hundreds of birds seen.

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[3] Check list of birds of the world, vol. 1. 1931, p. 81.

[4] Amer. Sportsman, vol. 3, no. 24, Mar. 14, 1874, p. 379.

Suborder FREGATAE

Family FREGATIDAE, Man-o'-war Birds

FREGATA MAGNIFICENS Mathews

FRIGATE-BIRD

Fregata minor magnificens MATHEWS, Austral Avian Rec., vol. 2, Dec. 19, 1914, p. 120 (Barrington Island, Galápagos Archipelago).

The five skins secured include an adult male, and an immature male with white head and underparts, taken 10 miles east of Baradères on April 6, and an adult female and two young shot on Navassa Island on May 10. One of the young is in down with contour feathers appearing on the back. The other has wings and tail partly developed and adult feathers appearing on back and breast. These specimens establish this species as a breeding bird of Navassa Island. Hundreds were observed here on the date when specimens were taken.

The frigate-bird was recorded also at Anse à Galets on March 22 and at Île à Vache on April 28.

Order CICONIIFORMES

Suborder ARDEAE

Family ARDEIDAE, Herons and Bitterns

ARDEA HERODIAS ADOXA Oberholser

WEST INDIAN GREAT BLUE HERON

Ardea herodias adoxa OBERHOLSER, Proc. U. S. Nat. Mus., vol. 43, Dec. 12, 1912, p. 544 (Curaçao Island).

A female was collected near the mouth of the Gibara River near Gibara, Cuba, on February 24. This specimen has the wing 430 mm, its small size and pale coloration being normal for the West Indian form.

A young bird barely grown was caught by a native 10 miles east of Baradères, Haiti, April 6. The fact that this individual was only recently from the nest indicates breeding for this species somewhere in that region, no nesting colonies being definitely known at this time either in Haiti or in the Dominican Republic. Two great blue herons were seen at Anse à Galets on Gonave Island on March 22.

CASMERODIUS ALBUS EGRETTA (Gmelin)

EGRET

Ardea Egretta GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 629 (Cayenne).

An adult female egret was taken by Lee Parish on the Moa River opposite Cayo Grande de Moa, Cuba, on March 8. The bird is in

full nuptial plumage in beautiful condition. Barbour[5] records both the egret and the snowy heron as rare in Cuba to-day.

LEUCOPHOYX THULA THULA (Molina)

SNOWY HERON

Ardea Thula MOLINA, Sagg. Stor. Nat. Chili, 1782, p. 235 (Chile).

Male and female were taken by S. W. Parish 4 miles east of Gibara, Cuba, on February 22. Both birds are in fully developed nuptial plumage in beautiful condition.

In view of the few records of this handsome heron for Haiti, it is of interest to report an adult female in beautiful breeding dress with the plumes fully developed taken by S. W. Parish on Grande Cayemite Island on April 12. The species has not been reported previously from this island.

Peters[6] is correct in using the genus *Leucophoyx* Sharpe for this species, which differs decidedly from *Egretta garzetta*, type of the genus *Egretta*, in form of crest and breast feathers.

HYDRANASSA TRICOLOR RUFICOLLIS (Gosse)

LOUISIANA HERON

Egretta ruficollis GOSSE, Birds of Jamaica, 1847, p. 338 (Burnt Savanna River, Jamaica).

A male, fully adult, was obtained at the mouth of the Moa River near Cayo Grande de Moa, Cuba, on March 16.

Another male in worn postjuvenal dress was collected at Petit Trou de Nippes, Haiti, April 9. Two others in full breeding plumage were secured on Grande Cayemite Island on April 12, and Île à Vache on May 6. One was seen on Petite Gonave Island on March 19. A specimen shot on Bug Island opposite Corail on April 18 was preserved in alcohol.

FLORIDA CAERULEA CAERULESCENS (Latham)

LITTLE BLUE HERON

Ardea caerulescens LATHAM, Index Orn., vol. 2, 1790, p. 690 (Cayenne).

Two were obtained near Gibara on February 21 and 24; one from Puerto de Tánamo, Cuba, March 2; and one from Cayo Grande de Moa, March 4. One of these is an immature bird in white dress, while the others are adults. The latter resemble other birds from the West Indies in darker coloration when compared with skins from the Southeastern United States.

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[5] Mem. Nutt. Orn. Club, no. 6, June, 1923, p. 28.

[6] Check-list of birds of the world, vol. 1, 1931, p. 113.

Three specimens from Haiti prepared as skins include adults in full breeding plumage taken on Petite Gonave Island on March 19 and Petite Cayemite on April 14. A young bird in mixed slate and white dress was collected on Île à Vache on May 3.

Of three of these birds preserved in skeleton form two were taken 4 miles east of Gibara, Cuba, on February 22, and another at Grand-Boucan, Haiti, on April 9. Two taken at Bug Island, opposite Corail, Haiti, on April 18 were preserved in alcohol.

BUTORIDES VIRESCENS MACULATUS (Boddaert)

WEST INDIAN GREEN HERON

Cancroma maculata BODDAERT, Table Planches Enl., 1783. p. 54 (Martinique, Lesser Antilles).

Two males collected above the mouth of the Río Gibara, near the town of Gibara, Cuba, on February 24 and 25, are representatives of the West Indian race of this species. They have wing measurements of 166 and 168 mm, respectively.

Adult specimens of this heron were taken at Montet near Port au Prince on March 27; on Petite Gonave Island on March 19; 10 miles east of Baradères on April 6; Grande Cayemite on April 13 (skeleton); and on Île à Vache on April 28 and May 3. Three young birds were taken from a nest on Île à Vache on the date last mentioned. One of these, recently from the egg, has the long down of the upper surface and wings mouse gray, and of the under surface white.

NYCTANASSA VIOLACEA VIOLACEA (Linnaeus)

YELLOW-CROWNED NIGHT HERON

Ardea violacea LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 143 (South Carolina).

A male was collected on Cayo Grande de Moa, Cuba, on March 4.

Three in immature plumage were obtained at Baradères, Haiti, on April 10, and on Petite Cayemite Island on April 13 and 15. An adult female was collected on Île à Vache on May 6, and skeletons were taken at the same point April 30 and May 6. One skeleton and two young in alcohol come from Bigie Bay, April 23.

IXOBRYCHUS EXILIS EXILIS (Gmelin)

EASTERN LEAST BITTERN

Ardea exilis GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 645 (Jamaica).

Three were obtained at Montet near Port au Prince on March 27, 1930, when about 15 were observed along a small stream. The two skins preserved, a pair, seem normal in coloration.

Order ANSERIFORMES

Family ANATIDAE, Ducks, Geese, and Swans

DENDROCYGNA ARBOREA (Linnaeus)

WEST INDIAN TREE-DUCK

Anas arborea LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 128 (Jamaica [7])

One male and three females were secured by S. W. Parish on Île à Vache in May.

Order FALCONIFORMES

Suborder FALCONES

Family ACCIPITRIDAE, Hawks and Eagles

BUTEO JAMAICENSIS JAMAICENSIS (Gmelin)

WEST INDIAN RED-TAILED HAWK

Falco jamaicensis GMELIN, Syst. Nat., vol. 1, pt. 1, 1788, p. 266 (Jamaica).

Two adult specimens in fine plumage were taken, a male at the western end of Gonave Island on March 21, and a female on Petite Cayemite on April 10. The female has the dark area on the abdomen more extensive and the black more nearly continuous than the male.

BUTEO RIDGWAYI (Cory)

RIDGWAY'S HAWK

Rupornis ridgwayi CORY, Quart. Journ Boston Zoöl. Soc., vol. 2, Oct., 1883, p. 46 (Samaná, Dominican Republic).

The three skins taken on Île à Vache on April 30 and May 1 constitute records from a new locality for an interesting bird that apparently is now rare except on the Cayemite Islands where Abbott secured a number. Two of the skins obtained are adult males, and the third is an immature bird fully grown. The species has been seldom recorded in recent years on the main island and may be diminishing in numbers. A female taken on April 30 was preserved as a skeleton.

Doctor Hellmayr informs me that Cory's types were labeled Samaná, the male being taken on April 19 and the female on April 4, 1883, so that Samaná, Dominican Republic, is the type locality for this species.

Peters [8] holds that the group of species usually segregated as the genus *Rupornis* has no trenchant characters that will separate them from *Buteo*, in which assumption he appears correct.

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[7] See Peters, Check list of birds of the world, vol 1, 1931, p. 154

[8] Check list of birds of the world, vol. 1, 1931, p. 228

Family FALCONIDAE, Falcons and Caracaras

FALCO SPARVERIUS SPARVERIOIDES Vigors

CUBAN SPARROW HAWK

Falco sparverioides VIGORS, Zool. Journ., vol. 3, Dec., 1827, p. 436 (Havana, Cuba).

The usual two color phases are represented in the four specimens obtained. Male and female obtained above the mouth of Río Gibara, near Gibara, Cuba, are in the light phase, while two others, also male and female, from the Río Fabrico, opposite Cayo Grande de Moa, are strongly rufescent.

FALCO SPARVERIUS DOMINICENSIS Gmelin

HISPANIOLAN SPARROW HAWK

Falco dominicensis GMELIN, Syst. Nat., vol. 1, pt. 1, 1788, p. 285 (Hispaniola).

Skins were taken as follows: Male, western end of Gonave Island, Haiti, March 21; Thomazeau, April 1; Petite Cayemite Island, April 14; Île à Vache, April 27. These show the usual variation in the amount of brown across the chest.

Order GRUIFORMES

Suborder GRUES

Family ARAMIDAE, Limpkins

ARAMUS PICTUS ELUCUS Peters

LIMPKIN

Aramus pictus elucus PETERS, Occ. Pap. Boston Soc. Nat. Hist., vol. 5, Jan. 30, 1925, p. 143 (Sosúa, Dominican Republic).

A male, an excellent specimen, was obtained by S. W. Parish at Montet near Port au Prince on May 17. This bird has the following measurements: Wing, 317; tail, 132.2; culmen from base, 111.5; and tarsus, 113.5 mm.

Family RALLIDAE, Rails

RALLUS LONGIROSTRIS VAFER Wetmore

HISPANIOLAN CLAPPER RAIL

Rallus longirostris vafer WETMORE, Proc. Biol. Soc. Washington, vol. 41, June 29, 1928, p. 121 (Étroites, Gonave Island, Haiti).

Three specimens taken include a male from Petite Gonave Island, March 19; a female from Petit Trou de Nippes, April 9; and a male

from Grande Cayemite Island, April 11. These agree in color with the series of skins from which this subspecies was described. The three localities represent new records in the distribution of this bird. Measurements are as follows:

Males: Wing, 152–154; tail, 65.4–68.7; culmen from base, 67.5–68.7; tarsus, 59–59.5 mm.

Female: Wing, 143.6; tail, 59; culmen from base, 60.8; tarsus, 51.9 mm.

The specimen from Grande Cayemite is the first report of this bird from that island.

IONORNIS MARTINICUS (Linnaeus)

PURPLE GALLINULE

Fulica martinica LINNAEUS, Syst. Nat., ed, 12, vol. 1, 1766, p. 259 (Martinique).

A female was collected by Lee Parish on April 10 near Baradères.

GALLINULA CHLOROPUS PORTORICENSIS Danforth

ANTILLEAN GALLINULE

Gallinula chloropus portoricensis DANFORTH, Auk, 1925, p. 560 (Cartagena Lagoon, Porto Rico).

Two skins were obtained at Montet, near Port au Prince, where these birds were common, on March 27. On this date a nest containing one egg was found. Another was collected at Petit Trou de Nippes on April 9, and still another on Île à Vache on May 6. Skeletons were prepared at all three localities.

Order CHARADRIIFORMES

Suborder CHARADRII

Family CHARADRIIDAE, Plovers, Turnstones, and Surf-birds

CHARADRIUS SEMIPALMATUS Bonaparte

SEMIPALMATED PLOVER

Charadrius semipalmatus BONAPARTE, Journ. Acad. Nat. Sci. Philadelphia, vol. 5, Aug., 1825, p. 98 (Coast of New Jersey).

A female was collected on Petite Gonave Island on March 19, and two were seen at Montet, near Port au Prince, on March 28.

PAGOLLA WILSONIA RUFINUCHA (Ridgway)

RUFOUS-NAPED PLOVER

Aegialitis Wilsonius var. *rufinucha* RIDGWAY, Amer. Nat., vol. 8, Feb., 1874, p. 109 (Spanishtown, Jamaica).

Two males obtained on March 4 on Cayo Grande de Moa, Cuba, have the darker dorsal coloration that distinguishes the West Indian

form of this bird from that of southeastern North America. According to Barbour this plover is an uncommon resident in Cuba. Two others shot at the same locality were made into skeletons. In Haiti specimens of this bird were obtained at Grand-Boucan on April 9, and on Grande Cayemite on April 13.

OXYECHUS VOCIFERUS RUBIDUS Riley

West Indian Killdeer

Oxyechus vociferus rubidus Riley, Proc. Biol. Soc. Washington, vol. 22, Apr. 17, 1909, p. 88 (Hispaniola).

A female, representative of the resident race of killdeer, was taken at Petit Trou de Nippes on April 9. This specimen is very small, having a wing measurement of only 147.1 mm. Another collected at the same time was preserved as a skeleton.

SQUATAROLA SQUATAROLA CYNOSURAE Thayer and Bangs

American Black-bellied Plover

Squatarola squatarola cynosurae Thayer and Bangs, Proc. New England Zoöl. Club, vol. 5, Apr. 9, 1914, p. 23 (Baillie Island, Arctic America).

A female still in winter plumage was shot above the mouth of the Río Gibara, near Gibara, Cuba, on February 25, and a male in full winter dress was obtained at Grand-Boucan on April 9.

ARENARIA INTERPRES MORINELLA (Linnaeus)

Ruddy Turnstone

Tringa Morinella Linnaeus, Syst. Nat., ed. 12, vol. 1, 1766, p. 249 (coast of Georgia).

One obtained on Bug Island, near Corail, Haiti, on April 18, was preserved in alcohol.

Family SCOLOPACIDAE, Woodcock, Snipe, and Sandpipers

ACTITIS MACULARIA (Linnaeus)

Spotted Sandpiper

Tringa macularia Linnaeus, Syst. Nat., ed. 12, vol. 1, 1766, p. 249 (Pennsylvania).

Skeletons were obtained near the mouth of the Gibara River, Cuba, on February 24, and at Cayo Grande de Moa on March 4.

A female in full breeding plumage was collected on Île à Vache, Haiti, on May 6. The date is rather late for this migrant from the north.

TRINGA SOLITARIA SOLITARIA Wilson

EASTERN SOLITARY SANDPIPER

Tringa solitaria WILSON, Amer. Orn., vol. 7, 1813, p. 53, pl. 58, fig. 3 (Pocono Mountains, Pa.).

A female in full summer plumage was taken at Montet, near Port au Prince, on March 28.

CATOPTROPHORUS SEMIPALMATUS SEMIPALMATUS (Gmelin)

EASTERN WILLET

Scolopax semipalmata GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 659 (New York).

A male in full breeding plumage was taken on Cayo Grande de Moa on March 4. Barbour, in his memoir on the avifauna of this island,[9] says that he has seen few willets in Cuba.

TOTANUS FLAVIPES (Gmelin)

LESSER YELLOWLEGS

Scolopax flavipes GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 659 (New York).

One preserved as a skeleton was obtained near the mouth of the Gibara River, Cuba, on February 24. A female in summer plumage, except for the back where it is still in molt, was taken on Petite Gonave Island on March 19. Another preserved as a skeleton was taken at the same place on the same date, and one was seen at Montet, near Port au Prince, on March 28.

PISOBIA MINUTILLA (Vieillot)

LEAST SANDPIPER

Tringa minutilla VIEILLOT, Nouv. Dict. Hist. Nat., vol. 34, 1819, p. 466 (Halifax, Nova Scotia).

A female was obtained at Grand-Boucan on April 9.

EREUNETES PUSILLUS (Linnaeus)

SEMIPALMATED SANDPIPER

Tringa pusilla LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 252 (Hispaniola).

A female was secured at Grand-Boucan on April 9.

[9] Barbour, T., Mem. Nuttall Orn. Club, no. 6, June, 1923, p. 67.

Family RECURVIROSTRIDAE, Avocets and Stilts

HIMANTOPUS MEXICANUS (Müller)

BLACK-NECKED STILT

Charadrius Mexicanus MÜLLER, Natursyst., Suppl., 1776, p. 117 (Mexico).

Four skins obtained were collected by Lee and S. W. Parish at Petit Trou de Nippes and Grand-Boucan on April 9; Petite Cayemite Island on April 13; and Île à Vache on May 6. These localities give additional detail in the distribution of this species, which is resident locally in the coastal plain.

Order COLUMBIFORMES

Suborder COLUMBAE

Family COLUMBIDAE, Doves and Pigeons

COLUMBA LEUCOCEPHALA Linnaeus

WHITE-CROWNED PIGEON.

Columba leucocephala LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 164 (Bahama Islands).

Two specimens of this widely distributed pigeon were taken on the Río Fabrico opposite Cayo Grande de Moa, Cuba, on March 6 and 8. In Haiti seven others were prepared as skins as follows: Petite Gonave Island, March 19, two males; Grande Cayemite Island, April 11, male; Petite Cayemite Island, April 12 and 13, male and female; Île à Vache, April 30 and May 2, two males. In addition to these a number of skulls and skeletons were preserved. The species was common in all these island localities.

COLUMBA SQUAMOSA Bonnaterre

SCALED PIGEON

Columba squamosa BONNATERRE, Tableau Enc. Méth., vol. 1, 1792, p. 234 (Guadeloupe Island, West Indies).

Two were shot on the Río Fabrico opposite Cayo Grande de Moa on March 7 and 8.

ZENAIDA ZENAIDA ZENAIDA (Bonaparte)

ZENAIDA DOVE

Columba zenaida BONAPARTE, Journ. Acad. Nat. Sci. Philadelphia, vol. 5, June 30, 1825, p. 30 (Florida Keys).

A female taken at Cayo Grande de Moa, Cuba, on March 6, was preserved as a skeleton, and the following day a male in deeply col-

ored plumage was obtained. An adult female was taken at the western end of Gonave Island March 21, and a male, prepared as a skeleton, on Grande Cayemite on April 12. The species is here first recorded for the last island mentioned.

ZENAIDURA MACROURA MACROURA (Linnaeus)

CUBAN MOURNING DOVE

Columba macroura LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 164 (Cuba).

An adult male was taken near Gibara, Cuba, on February 22. Two eggs collected near the same point on February 24 are white and have the following measurements: 27.4 by 20.3 and 27.1 by 20 mm. In Haiti a male mourning dove was secured near Montet on March 28.

MELOPELIA ASIATICA ASIATICA (Linnaeus)

EASTERN WHITE-WINGED DOVE

Columba asiatica LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 163 (Jamaica).

A female was taken at Puerto de Tánamo, Cuba, on March 2. This bird has the rump brownish like the back, instead of gray as in other skins seen from Jamaica, Hispaniola, and Old Providence Island. It is the only one from Cuba in the collections of the National Museum.

Other skins were obtained on Petite Gonave Island on March 19; ten miles southwest of Port au Prince on March 31; at Grand-Boucan on April 9; and on Petite Cayemite on April 12. Birds were observed near the western end of Gonave Island on March 21. Skeleton or alcoholic specimens were obtained at Bug Island, opposite Corail, on April 18, and at Île à Vache on May 3, two juvenile birds being included from the latter locality.

COLUMBIGALLINA PASSERINA INSULARIS Ridgway

CUBAN GROUND DOVE

Columbigallina passerina insularis RIDGWAY, Proc. U. S. Nat. Mus., vol. 10, 1887, p. 574 (Grand Cayman).

Two males and one female were obtained near Gibara on February 21. On February 24 a set of two eggs was taken here, one of them being broken. The other measures 21.9 by 16.4 mm. The size of this egg is similar to that of specimens I have seen from Haiti.

Four skins taken on Petite Cayemite Island on April 13 and 15, and three obtained on Île à Vache on April 30, are similar to specimens from the main island of Haiti. In addition to these, skeletons or alcoholics were obtained at the western end of Gonave Island on March 21, and at Grand-Boucan on April 9, with others from Gibara, Petite Cayemite, and Île à Vache.

It has recently been decided that the generic name for this group, currently known as *Chaemepelia* (also spelled *Chamaepelia*), must again become *Columbigallina*.[10]

COLUMBIGALLINA PASSERINA NAVASSAE (Wetmore)

NAVASSA GROUND DOVE

Chaemepelia passerina navassae WETMORE, Proc. Biol. Soc. Washington, vol. 43, Sept. 26, 1930, p. 149 (Navassa Island).

This race, similar to *C. p. insularis* but grayer, less brownish on the dorsal surface, lighter below, and averaging somewhat smaller, was described from two males and three females collected on Navassa Island on May 10 by S. W. Parish and W. M. Perrygo. Following is the original description of the type specimen:

Type, U. S. N. M. No. 317212, male adult, Navassa Island, May 10, 1930, collected by W. M. Perrygo (original number, 566). Back, rump, and upper tail-coverts hair brown; hindneck and posterior part of crown dawn gray, with each feather margined narrowly with deep neutral gray, producing a scalloped appearance; forepart of crown slightly brighter than avellaneous; lesser and middle wing-coverts and inner scapulars between vinaceous-fawn and fawn color, becoming grayer toward outer margin of wing, the inner feathers spotted with plum purple, the spots having a metallic sheen; concealed portions of primaries and outer secondaries pecan brown; inner secondaries and tips and outer margins of outer secondaries and primaries blackish brown; ninth primary with a very narrow whitish margin on distal part of outer web; sixth to eighth primaries with a narrow margin of pecan brown on outer web; primary coverts pecan brown at base and dull blackish at tips; middle pair of rectrices deep mouse gray; others black with a narrow white edging on outer web of outermost at distal end; chin and throat whitish with a wash of avellaneous; line behind eye vinaceous-fawn; feathers of sides of head and sides of upper foreneck pale vinaceous-fawn, with narrow terminal margins of fawn color; those of lower foreneck and breast blackish basally, with a narrow margin of pale vinaceous-fawn and a very narrow distal edging of fawn color; lower breast and sides between avellaneous and vinaceous-fawn; abdomen dull whitish; under tail-coverts basally hair brown, margined broadly with dull whitish; under surface of wings Mikado brown. Bill blackish at tip; yellowish brown basally; cere blackish brown; tarsus and toes dull sayal brown (from dried skins).

Measurements are as follows: Males, five specimens: Wing, 79.6–82 (80.9); tail, 51.6–57.5 (54.8); culmen with cere, 9.8 (10.8[11]); tarsus, 14.8–16 (15.2) mm.

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[10] This name is used in the A. O U. check-list of North American birds, 4th ed., 1931, p. 155.

[11] Four specimens

Females, five specimens: Wing, 76.2–83 (80); tail, 52.4–57.5 (53.6); culmen with cere, 11.1–11.7 (11.4[12]); tarsus, 13.8–15.8 (14.7) mm.

Type, male: Wing, 81; tail, 55; culmen with cere, 10.8; tarsus, 14.8 mm.

The differences marking the ground dove of Navassa Island were first observed in examining three males and three females in the collections of the American Museum of Natural History obtained in July, 1917, by R. H. Beck. These skins were in considerably worn dress, and after some consideration they were laid aside, since there was possibility that the lighter coloration was due to wear and fading. The receipt of five skins in unworn plumage taken during work of the Parish–Smithsonian expedition of 1930 substantiates the earlier observations of lighter color and leaves no hesitation in describing this race. The differences noted are more obvious in females than in males.

Though occasional skins of *C. p. insularis* are closely similar to *C. p. navassae*, the average of *insularis* is decidedly darker. It is interesting to note that the variation of the Navassa Island bird is in the direction of *C. p. exigua* Riley from Mona Island in the passage between Porto Rico and the Dominican Republic, environmental conditions on Mona and Navassa from available information being much the same.

In addition to the skins listed one male was prepared as a skeleton.

OREOPELEIA MONTANA (Linnaeus)

RUDDY QUAIL-DOVE

Columba montana LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 163 (Jamaica).

Three specimens, one preserved as a skeleton, were taken 10 miles east of Baradères on April 6. There are few records for this species from the Republic of Haiti.

OREOPELEIA CHRYSIA (Bonaparte)

KEY WEST QUAIL-DOVE

Geotrygon chrysia BONAPARTE, Comp. Rend. Acad. Sci. (Paris), vol. 40, 1855, p. 100 (Florida).

A female was secured by Lee Parish on Petite Cayemite Island on April 17. A male obtained on Gonave Island on March 23 was prepared as a skeleton.

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[12] Three specimens.

Order PSITTACIFORMES

Family PSITTACIDAE, Parrots, Paroquets, and Macaws

AMAZONA LEUCOCEPHALA LEUCOCEPHALA (Linnaeus)

CUBAN PARROT

Psittacus leucocephalus LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 100 (Cuba).

Two males and one female made into skins were taken on the Río Fabrico opposite Cayo Grande de Moa on March 6 and 7. Others obtained were prepared as skeletons and alcoholics. The form of this bird found on the island of Cuba proper is reputed to be growing steadily more rare.

Order CUCULIFORMES

Suborder CUCULI

Family CUCULIDAE, Cuckoos, Roadrunners, and Anis

COCCYZUS MINOR TERES Peters

MANGROVE CUCKOO

Coccyzus minor teres PETERS, Proc. New England Zoöl. Club, vol. 9, June 24, 1927, p. 112 (Sosúa, Dominican Republic).

A female was obtained at Palma, in the interior of Gonave Island back of Anse à Galets, on March 23, and a male and a female were secured on Île à Vache on April 27. The latter seem similar to birds from the main island.

SAUROTHERA MERLINI MERLINI d'Orbigny

CUBAN LIZARD-CUCKOO

Saurothera merlini D'ORBIGNY, *in* La Sagra, Hist. Fis. Pol. Nat. Isla de Cuba, pt. 2, vol. Aves, 1839, p. 115, pl. 25 (Cuba).

Skins were forwarded from Gibara on February 25; Tánamo on March 2; and the Río Moa opposite Cayo Grande de Moa on March 6.

SAUROTHERA LONGIROSTRIS LONGIROSTRIS (Hermann)

HISPANIOLAN LIZARD-CUCKOO

Cuculus longirostris HERMANN, Tab. Affin. Anim., 1783, p. 186 (Hispaniola).

Male and female were taken at Bigie Bay on April 21. A male secured near Baradères on April 6 was prepared as a skeleton.

CROTOPHAGA ANI Linnaeus

ANI

Crotophaga ani LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 105 (Jamaica).

Three were obtained at Gibara, Cuba, on February 21, and one on the Río Fabrico opposite Cayo Grande de Moa on March 8. Other skins were forwarded from near Port au Prince on March 28, Grande Cayemite Island on April 12, Île à Vache on April 27 and 30, and Navassa Island on May 10. The specimen from Navassa seems to indicate that this curious bird is found there regularly, since there is an old skin in the National Museum obtained on this island December 3, 1890, by J. F. R. Dufour.

Order STRIGIFORMES

Family TYTONIDAE, Barn Owls

TYTO GLAUCOPS (Kaup)

HISPANIOLAN BARN OWL

Strix glaucops KAUP, Jardine's Contr. Ornith., 1852, p. 118 (Dominican Republic).

A female was taken in a cave 10 miles east of Baradères on April 6. This bird is in the brownish phase of plumage.

Family STRIGIDAE, Typical Owls

SPEOTYTO CUNICULARIA TROGLODYTES Wetmore and Swales

HISPANIOLAN BURROWING OWL

Speotyto cunicularia troglodytes WETMORE and SWALES, U. S. Nat. Mus. Bull. 155, Mar. 7, 1931, p. 239 (Haiti).

Male and female were taken at Thomazeau on April 1 by Lee Parish.

Order CAPRIMULGIFORMES

Suborder CAPRIMULGI

Family CAPRIMULGIDAE, Goatsuckers

ANTROSTOMUS CAROLINENSIS (Gmelin)

CHUCK-WILL'S-WIDOW

Caprimulgus carolinensis GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 1028 (South Carolina).

A female was shot at Tánamo on March 1.

Order MICROPODIFORMES

Suborder MICROPODII

Family MICROPODIDAE, Swifts

TACHORNIS PHOENICOBIA PHOENICOBIA Gosse

PALM SWIFT

Tachornis phoenicobia GOSSE, Birds of Jamaica, 1847, p. 58 (Jamaica).

A female of this interesting swift was taken by Lee Parish at Petit Trou de Nippes on April 9.

Suborder TROCHILI

Family TROCHILIDAE, Hummingbirds

MELLISUGA MINIMA VIELLOTI (Shaw)

HISPANIOLAN VERVAIN HUMMINGBIRD

Trochilus vielloti SHAW, Gen. Zool., vol. 8, pt. 1, 1812, p. 347 (Hispaniola).

Specimens that were preserved in alcohol were obtained on Gonave Island on March 23, and on Petite Cayemite Island on April 13 and 14.

RICCORDIA RICORDII RICORDII (Gervais)

RICORD'S EMERALD HUMMINGBIRD

Trochilus ricordii GERVAIS, Mag. Zool., Mar., 1835, Cl. II, pls. 41, 42 (Santiago, Cuba).

A male was taken near Gibara on February 21, and a female on Turones Cay, near Puerto de Tánamo, on March 2.

ANTHRACOTHORAX DOMINICUS (Linnaeus)

HISPANIOLAN MANGO HUMMINGBIRD

Trochilus dominicus LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 191 (Hispaniola).

This large hummingbird is represented by five skins and five skeletons and alcoholics taken on Gonave Island on March 21 and 23; Petite Cayemite Island on April 13 and 17; and Île à Vache on April 30 and May 1. The species is common on Gonave, and is reported here for the first time from Petite Cayemite and Île à Vache.

Order TROGONIFORMES

Family TROGONIDAE, Trogons

TEMNOTROGON ROSEIGASTER (Vieillot)

HISPANIOLAN TROGON

Trogon roseigaster VIEILLOT, Nouv. Dict. d'Hist. Nat., vol 8, 1817, p. 314 (Hispaniola).

A male and a female in excellent plumage were taken 10 miles east of Baradères, Haiti, on April 6 by W. M. Perrygo. A skeleton of this species was prepared at Petit Trou de Nippes on April 9, and another at Bigie on April 23.

PRIOTELUS TEMNURUS TEMNURUS (Temminck)

CUBAN TROGON

Trogon temnurus TEMMINCK, Nouv. Rec. Planch. Col. Ois., livr. 55, Feb., 1825, pl. 326 ("Cuba et à la Havane").

Three taken were obtained at Puerto de Tánamo on March 1 and 2, and 2 miles above the mouth of the Río Moa, opposite Cayo Grande de Moa, on March 6.

Order CORACIIFORMES

Suborder ALCEDINES

Family ALCEDINIDAE, Kingfishers

MEGACERYLE ALCYON ALCYON (Linnaeus)

EASTERN BELTED KINGFISHER

Alcedo alcyon LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 115 (South Carolina).

A female was secured near Baradères on April 11 by S. W. Parish. This bird is in considerably worn plumage and apparently had not renewed its plumage properly at the last molt.

Family TODIDAE, Todies

TODUS MULTICOLOR EXILIS Barbour and Brooks

EASTERN CUBAN TODY

Todus multicolor exilis BARBOUR and BROOKS, Proc. New England Zoöl. Club, vol. 6, Jan. 13, 1917, p. 51 (Preston, Nipe Bay, Province of Oriente, Cuba).

Two were taken near Puerto de Tánamo, Cuba, on March 1.

Examination of the considerable series of Cuban todies in the National Museum collections indicates that the two races differentiated by Barbour and Brooks are easily distinguished, the eastern

bird having the blue on the side of the neck paler, and the yellow patch at the base of the forehead slightly duller and of less extent. As the ranges of the two forms remain to be worked out in detail, localities for the specimens in our collection are listed, as follows:

Todus multicolor multicolor: Baños San Vicente, San Diego de los Baños, Cabanas, and El Guama in Pinar del Río Province; Nueva Gerona, Isle of Pines.

Todus multicolor exilis: Santiago, Guantanamo, San Luis, Guama, El Cobre, and Puerto de Tánamo, in Oriente Province.

TODUS SUBULATUS Gray

HISPANIOLAN TODY

Todus subulatus "Gould" GRAY, Gen. Birds, vol. 1, Apr., 1847, pl. 22 (Hispaniola).

Skins and alcoholics of the omnipresent lowland tody were obtained at the western end of Gonave Island, Haiti, on March 21, and a skin 10 miles east of Baradères on April 6. A skeleton was preserved at Bigie on April 23.

Order PICIFORMES

Suborder PICI

Family PICIDAE, Woodpeckers

XIPHIDIOPICUS PERCUSSUS PERCUSSUS (Temminck)

CUBAN GREEN WOODPECKER

Picus percussus TEMMINCK, Nouv. Rec. Planch. Col. Ois., livr. 66, June, 1826, pl. 390 and 424, with text (Cuba).

Two were taken at Tánamo, March 1.

CHRYSERPES STRIATUS (Müller)

HISPANIOLAN WOODPECKER

Picus striatus MÜLLER, Vollst. Naturs., Suppl. Reg.-Band, 1776, p. 91 (Hispaniola).

Skins of this abundant woodpecker were obtained at Port au Prince on March 28 and 31, ten miles east of Baradères on April 6, and near Petit Trou de Nippes on April 9. Two skeletons were preserved from Thomazeau on April 1 and Baradères on April 6.

CENTURUS SUPERCILIARIS SUPERCILIARIS (Temminck)

SUPERCILIARY WOODPECKER

Picus superciliaris TEMMINCK, Nouv Rec. Planch. Col. Ois., livr. 73, July, 1827, pl. 433, with text (Cuba).

Four specimens: Gibara, February 25; Tánamo, March 2; mouth of Río Moa, opposite Cayo Grande de Moa, March 6.

NESOCTITES MICROMEGAS (Sundevall)

HISPANIOLAN PICULET

Picumnus micromegas SUNDEVALL, Consp. Avium Pic., 1866, p. 96 (Hispaniola).

Two males were obtained by S. W. Parish and W. M. Perrygo 10 miles east of Baradères. The piculet was collected a little farther east, near Miragoane, by James Bond, and from the present record it may be expected to range throughout the southwestern peninsula.

Order PASSERIFORMES

Suborder TYRANNI

Family TYRANNIDAE, Tyrant Flycatchers

TYRANNUS DOMINICENSIS DOMINICENSIS (Gmelin)

GRAY KINGBIRD

Lanius dominicensis GMELIN, Syst. Nat., vol. 1, pt. 1, 1788, p. 302 (Hispaniola).

The 11 skins taken of the omnipresent gray kingbird come from the following localities: Gibara, Cuba, February 25; 10 miles southwest of Port au Prince, Haiti, March 31; Petite Gonave Island, March 19; Grande Cayemite Island, April 13; Petite Cayemite Island, April 12 and 13; Île à Vache, April 30 and May 3. The presence of this bird on the smaller islands is of interest.

Young individuals preserved in alcohol were taken on Petite Cayemite on April 16 and on Île à Vache on May 3.

TYRANNUS CUBENSIS Richmond

GIANT KINGBIRD

Tyrannus cubensis RICHMOND, Auk 1898, p. 330 (Cuba).

A male was taken on March 8 near the mouth of the Río Fabrico, opposite Cayo Grande de Moa. The giant kingbird is reported now to be rare.

TOLMARCHUS CAUDIFASCIATUS CAUDIFASCIATUS (d'Orbigny)

CUBAN PETCHARY

Tyrannus caudifasciatus D'ORBIGNY, *in* La Sagra, Hist. Fis. Pol. Nat. Cuba, pt. 2, vol. 3, Aves, 1839, p. 70, pl. 12 (Cuba).

Three were taken at Gibara on February 21 and one at Puerto de Tánamo on March 2.

TOLMARCHUS GABBII (Lawrence)

HISPANIOLAN PETCHARY

Pitangus Gabbii LAWRENCE, Ann. Lyc. Nat. Hist. New York, vol. 11, 1876, p. 288 (Hato Viejo, Mao River, Province of Santiago, Dominican Republic).

A female was taken on the Baradères Peninsula on April 8.

MYIARCHUS SAGRAE SAGRAE (Gundlach)

CUBAN CRESTED FLYCATCHER; LA SAGRA'S FLYCATCHER

Muscicapa Sagrae GUNDLACH, Boston Journ. Nat. Hist., vol. 6, 1852, p. 313 (Cuba).

A female comes from Puerto de Tánamo taken on March 1.

MYIARCHUS DOMINICENSIS (Bryant)

HISPANIOLAN FLYCATCHER

Tyrannula stolida (var. *dominicensis*) BRYANT, Proc. Boston Soc. Nat. Hist., vol. 11, May, 1867, p. 90 (Port au Prince, Haiti).

This small flycatcher is represented by a series of six skins from the following localities: Montet, near Port au Prince, March 28; Gonave Island, March 21; Petite Cayemite Island, April 12 and 14; and Île à Vache, May 6. It has not been recorded previously from the two latter localities.

BLACICUS CARIBAEUS (d'Orbigny)

CUBAN WOOD PEWEE

Muscipeta caribaea D'ORBIGNY, *in* La Sagra, Hist. Fis. Pol. Nat. Cuba, pt. 2, vol. 3, Aves, 1839, p. 77 (Cuba).

Two were taken at Gibara on February 21, and a third at Puerto de Tánamo on March 1. After comparison of a very good series, I consider the wood pewee of Cuba specifically distinct from that of the Bahamas, though Doctor Hellmayr[13] has treated them as geographic representatives of the same species.

[13] Catalogue of birds of Americas, Field Mus. Nat. Hist., zool. ser., vol. 13, Apr. 11, 1927, p. 204.

Suborder PASSERES

Family HIRUNDINIDAE, Swallows

RIPARIA RIPARIA RIPARIA (Linnaeus)

BANK SWALLOW

Hirundo riparia LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 192 (Sweden).

A specimen of this migrant from North America was taken near the western end of Île à Vache on April 27 by S. W. Parish. The record is of particular interest since the species has been taken only once before in Hispaniola, the previous record being that of Ritter, who reports that he obtained one during his travels in Haiti in 1820 and 1821. The bank swallow is known as a migrant in the adjacent islands of Porto Rico, Cuba, and Jamaica and may therefore be more regular in occurrence in Hispaniola than the two observations at present known seem to indicate.

PETROCHELIDON FULVA FULVA (Vieillot)

HISPANIOLAN CLIFF SWALLOW

Hirundo fulva VIEILLOT, His. Nat. Ois. Amér. Sept., vol. 1, 1807 (1808?), p. 62, pl. 32 (Hispaniola).

Half a dozen pairs were observed about the low cliffs at the western end of Gonave Island on March 21 and two birds were taken. A male and a female in full plumage were secured at the western end of Île à Vache, May 2. Following are measurements for these specimens:

Male: Wing, 99; tail, 43.3; culmen from base, 8.5; tarsus, 10.8 mm.

Females (two specimens): Wing, 99.7–100.8; tail, 43.6–45; culmen from base, 8.4–8.8; tarsus, 11.2–12 mm.

One preserved as a skeleton was taken at the same point on May 5.

PROGNE DOMINICENSIS (Gmelin)

CARIBBEAN MARTIN

Hirundo dominicensis GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 1025 (Hispaniola).

Two adult males were secured 10 miles east of Baradères on April 6.

Family MIMIDAE, Mockingbirds and Thrashers

MIMUS POLYGLOTTOS ORPHEUS (Linnaeus)

JAMAICAN MOCKINGBIRD

Turdus orpheus LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 169 (Jamaica).

A male of this widely distributed mocker was taken near Gibara on February 21.

MIMUS POLYGLOTTOS DOMINICUS (Linnaeus)

HISPANIOLAN MOCKINGBIRD

Turdus dominicus LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 295 (Hispaniola).

Five adult birds were obtained at Montet, near Port au Prince, on March 28; at the western end of Gonave Island on March 21; on Petite Cayemite Island on April 16; and on Île à Vache on April 27 and 30.

DUMETELLA CAROLINENSIS (Linnaeus)

CATBIRD

Muscicapa carolinensis LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 328 (Virginia).

The catbird was taken at Gibara on February 24 and at Puerto de Tánamo on March 2. This species is a common winter resident in Cuba.

Family TURDIDAE, Thrushes, Bluebirds, and Solitaires

MIMOCICHLA RUBRIPES RUBRIPES (Temminck)

RED-LEGGED THRUSH

Turdus rubripes TEMMINCK, Nouv. Rec. Planch. Col. Ois., vol. 2, livr. 69, Oct., 1826, pl. 409 (Cuba).

A pair taken on February 21 four miles east of Gibara are typical of the red-legged thrush in the extent of brown on the abdomen.

MIMOCICHLA RUBRIPES SCHISTACEA Baird

SLATE-COLORED THRUSH

Mimocichla schistacea BAIRD, Rev. Amer. Birds, July, 1864, p. 37 (Monte Verde, Cuba).

A male was obtained on March 2 at Punta Gorda near Puerto de Tánamo, and a male and a female were taken on March 6 on the mainland near Cayo Grande de Moa. These three birds have the abdomen white without trace of brown.

This form seems to be restricted in its range in eastern Cuba, the occurrence of typical *M. r. rubripes* at Gibara only a short distance west of the points listed above being indicative of the limitation of range of these races on the north coast of the island. Though typical examples of *rubripes* and *schistacea* are very distinct, in the considerable series of these birds in the United States National Museum there are numerous examples from the region of Santiago that show a wash of brown of varying extent on the posterior underparts. Others from the same localities have no trace of this color. Intergradation seems to be clearly shown, so that *schistacea* is here treated as a subspecies of *rubripes*.

MIMOCICHLA ARDOSIACEA ARDOSIACEA (Vieillot)

HISPANIOLAN THRUSH

Turdus ardosiaceus VIEILLOT, Tabl. Enc. Méth., vol. 2, 1822, p. 646 (Hispaniola).

A male thrush was taken 10 miles east of Baradères on April 6, and others were seen at the western end of Gonave Island on March 21, and near Anse à Galets on March 22.

Family DULIDAE, Palm-chats

DULUS DOMINICUS DOMINICUS (Linnaeus)

PALM-CHAT

Tanagra dominica LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 316 (Hispaniola).

A female of the abundant palm-chat was taken at Petit Trou de Nippes on April 9, together with two juvenal birds that were placed in alcohol.

Family VIREONIDAE, Vireos

VIREO GUNDLACHII ORIENTALIS Todd

EAST CUBAN VIREO

Vireo gundlachii orientalis TODD, Ann. Carnegie Mus., vol. 10, Jan. 31, 1916, p. 256 (Arroyo Hondo, "Los Caños," Guantanamo, Cuba).

A male was secured above the mouth of the Río Gibara, near Gibara, on February 24.

The series of Gundlach's vireo in the National Museum, including 10 specimens from western Cuba and 7 from the eastern part of the island, bears out clearly the characters of difference assigned by Todd in distinguishing two races of this species. Without having examined the material in the Museum of Comparative Zoölogy on which Doctor Barbour [14] based his conclusion that *orientalis* was not valid, I am led to consider that it may be recognized. The eastern form is grayer above and clearer yellow below.

VIREO OLIVACEUS OLIVACEUS (Linnaeus)

JAMAICAN VIREO

Muscicapa olivacea LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 327 (Jamaica).

An extensive series of this vireo includes skins from the following localities: Gonave Island, March 21; ten miles east of Baradères, April 6; Petite Cayemite Island, April 12; Grande Cayemite Island, April 12; Île à Vache, May 1 and 2; Navassa Island, May 10. Four taken on Bug Island, opposite Corail, on April 18 were preserved in alcohol.

[14] Mem. Nuttall Orn. Club, no. 6, June, 1923, p. 107.

The single specimen from Navassa Island, an adult male in fresh plumage, is similar in color to the birds of Haiti proper.

It will be recalled that Bangs and Penard [15] have shown that the specific name *olivaceus* long current for the red-eyed vireo of eastern North America must apply to the Jamaican vireo, formerly known as *Vireo calidris*.

VIREO OLIVACEUS BARBATULA (Cabanis)

BLACK-WHISKERED VIREO

Phyllomanes barbatulus CABANIS, Journ. für Orn., 1855, p. 467 (Cuba).

Males of this form were secured on Gonave Island on March 21, and on Île à Vache on April 30. These are the first records of this subspecies from Hispaniola, the form being one that nests in the Bahamas, Cuba, and southern Florida. The two specimens obtained are considered migrants en route to their breeding range. It may be expected as a regular migrant in Haiti, and probably in the Dominican Republic.

This form differs from the resident Jamaican vireo in the paler, less buffy superciliary stripe and auricular region, grayer crown, duller olive-green of the back, and purer white throat and chest.

Family COEREBIDAE, Honey-creepers

COEREBA BANANIVORA BANANIVORA (Gmelin)

HISPANIOLAN HONEY-CREEPER

Motacilla bananivora GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 951 (Hispaniola).

Specimens collected come from the following localities: Western end of Gonave Island, March 21; Baradères Peninsula, April 8; Petite Cayemite Island, April 12 and 14; Bug Island, near Corail, April 18; Île à Vache, April 27 and 30 and May 2. Birds from Petite Cayemite Island and from Île à Vache appear identical with those of the main island.

Family COMPSOTHLYPIDAE, Wood Warblers

MNIOTILTA VARIA (Linnaeus)

BLACK AND WHITE WARBLER

Motacilla varia LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 333 (Hispaniola).

Males were shot 4 miles east of Gibara, Cuba, on February 21 and near the mouth of the Moa River on March 6. In Haiti one was taken on April 7 on the Baradères Peninsula, and a female was obtained on Île à Vache on May 6. The last-mentioned date is a late occurrence for this migrant from the north.

[15] Bull. Mus. Comp. Zoöl., vol. 67, 1925, pp. 205–206.

COMPSOTHLYPIS AMERICANA PUSILLA (Wilson)

NORTHERN PARULA WARBLER

Sylvia pusilla WILSON, Amer. Orn., vol. 4, 1811, p. 17, pl. 28, fig. 3 (eastern Pennsylvania).

One was obtained at Gibara on February 24, one at Puerto de Tánamo on March 2, and one near the mouth of the Río Moa, opposite Cayo Grande de Moa, on March 6.

DENDROICA PETECHIA GUNDLACHI Baird

CUBAN GOLDEN WARBLER

Dendroica gundlachi BAIRD, Rev. Amer. Birds, Apr., 1865, p. 197 (Cuba).

Two pairs were secured on Cayo Grande de Moa, Cuba, on March 4. Skeletons were prepared at Gibara on February 21, and at Cayo Grande de Moa on March 4.

DENDROICA PETECHIA ALBICOLLIS (Gmelin)

HISPANIOLAN GOLDEN WARBLER

Motacilla albicollis GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 983 (Hispaniola).

A specimen from Grande Cayemite taken on April 13 and two from Petite Cayemite taken on April 16 represent new localities for this bird in Haiti. They are referable to the form of the main island, being similar to it in size and color. Following are measurements taken from these three males: Wing, 62.3, 62.9, 63.4; tail, 50.7, 50, 49.9; culmen from base, 11.5, 11.9, 12.5; tarsus, 19.5, 20.3, 21.2 mm. Four preserved in alcohol were taken on Bug Island, near Corail, April 18.

DENDROICA PETECHIA SOLARIS Wetmore

GONAVE GOLDEN WARBLER

Dendroica petechia solaris WETMORE, Smithsonian Misc. Coll., vol. 81, no. 13, May 15, 1929, p. 1 (Ètroites, Gonave Island).

Two pairs of golden warblers taken on March 19 on Petite Gonave Island are, as might be expected, the race found on Gonave proper, being brighter in color and larger than skins from the adjacent coasts of the Republic of Haiti. Following are measurements from these four skins: Two males, wing, 65.7, 64.1; tail, 54.7, 54.5; culmen from base, 10.3, 11.8; tarsus, 21, 20.6 mm. Two females, wing, 61.5, 61; tail, 50.7, 53.1; culmen from base, 12, 11.8; tarsus, 21, 20.2 mm.

DENDROICA TIGRINA (Gmelin)

CAPE MAY WARBLER

Motacilla tigrina GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 985 (Canada).

One was shot near Gibara, Cuba, on February 24; one at Puerto de Tánamo on March 2; and one at Cayo Grande de Moa on March

4. All are in full plumage. The three skins in the collection from Haiti were taken on Petite Cayemite Island on April 13 and 16. Three shot on Bug Island, opposite Corail, on April 18 were preserved in alcohol.

DENDROICA CAERULESCENS CAERULESCENS (Gmelin)

BLACK-THROATED BLUE WARBLER

Motacilla caerulescens GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 960 (Hispaniola).

In Cuba, two were taken near Puerto de Tánamo on March 1; three on Cayo Grande de Moa on March 4; and one near the mouth of the Río Moa on March 6. All belong to the typical race.

An adult male taken on April 13 on Grande Cayemite Island, Haiti, is the first record for that island.

DENDROICA DOMINICA DOMINICA (Linnaeus)

YELLOW-THROATED WARBLER

Motacilla dominica LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 334 (Hispaniola).

One was secured on Cayo Grande de Moa on March 4.

DENDROICA VIRENS VIRENS (Gmelin)

BLACK-THROATED GREEN WARBLER

Motacilla virens GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 985 (Philadelphia, Pa.).

A male collected on April 30 on Île à Vache is the first record of this migrant from North America for Hispaniola. The species winters from eastern Mexico to Panama, there being few reports of it from the West Indies.

DENDROICA PALMARUM PALMARUM (Gmelin)

WESTERN PALM WARBLER

Motacilla palmarum GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 951 (Republic of Haiti).

Four species in the collection came from near Gibara, Cuba, on February 21 and 25. Others were obtained 10 miles southwest of Port au Prince, Haiti, on March 31; near Thomazeau on April 1; and on Grande Cayemite Island on April 13.

DENDROICA DISCOLOR DISCOLOR (Vieillot)

NORTHERN PRAIRIE WARBLER

Sylvia discolor VIEILLOT, Hist. Nat. Ois. Amér. Sept., vol. 2, 1807 (1808?, 1809?), p. 37, pl. 98 (New York).

Specimens were obtained near Gibara, Cuba, on February 24, and on Cayo Grande de Moa on March 4. Others were collected at Port

au Prince, Haiti, March 28 and 31; Petite Gonave Island, March 19; at the western end of Gonave Island, March 21; and on Grande Cayemite Island, April 13.

DENDROICA STRIATA (Forster)

BLACK-POLL WARBLER

Muscicapa striata J. R. FORSTER, Phil. Trans., vol. 62, 1772, pp. 406, 428 (Fort Severn, west coast of Hudson Bay).

Two black-poll warblers taken on May 2 and 6 on Île à Vache constitute an interesting record, since there has been only one previous report of this bird in the Republic of Haiti, that of James Bond who found it on Gonave Island on May 15, 1928.

SEIURUS AUROCAPILLUS AUROCAPILLUS (Linnaeus)

OVENBIRD

Motacilla aurocapilla LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 334 (at sea, about 30 miles from Hispaniola).

Four skins obtained come from 10 miles southwest of Port au Prince, Haiti, March 31; and from Petite Cayemite Island, April 14 and 15. One of the latter, a male, has the dark streaks on each side of the crown reduced to a very narrow line. One taken at Bigie Bay on April 23 was preserved in alcohol.

SEIURUS NOVEBORACENSIS NOVEBORACENSIS (Gmelin)

NORTHERN WATER-THRUSH

Motacilla noveboracensis GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 958 (New York).

A female with the browner coloration and smaller size representative of this race was taken on Cayo Grande de Moa, Cuba, on March 4.

A female from Petite Gonave Island, Haiti, March 19, and a male from Île à Vache, May 6, belong also to the eastern race of this bird. The latter date is later than the bird has been recorded previously from this region.

SEIURUS NOVEBORACENSIS NOTABILIS Ridgway

GRINNELL'S WATER-THRUSH

Seiurus naevius notabilis RIDGWAY, Proc. U. S. Nat. Mus., vol. 3, 1880, p. 12 (shores of Como Lake, Carbon County, Wyo.).

Two females were taken on Cayo Grande de Moa, Cuba, March 6.

A male from Grande Cayemite Island, taken April 13, adds another record of occurrence for this race in Haiti.

TERETISTRIS FORNSI Gundlach

FORNS'S WARBLER

Teretistris fornsi GUNDLACH, Ann. Lyc. Nat. Hist. New York, vol. 6, 1858, p. 274 (eastern portion of Cuba).

A female was collected on February 24 a mile above the mouth of the Río Gibara, near Gibara.

GEOTHLYPIS TRICHAS TRICHAS (Linnaeus)

MARYLAND YELLOWTHROAT

Turdus trichas LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 293 (Maryland).

Two yellowthroats came aboard the *Esperanza* near Bimini in the Bahamas about 10 a. m. on February 16. A male collected is of the present race.

GEOTHLYPIS TRICHAS BRACHIDACTYLA (Swainson)

NORTHERN YELLOWTHROAT

Trichas brachidactylus SWAINSON, Anim. in Menag., 1838, p. 295 (northern provinces of United States).

A male was taken at Montet near Port au Prince on March 28.

SETOPHAGA RUTICILLA (Linnaeus)

REDSTART

Motacilla ruticilla LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 186 (Virginia).

A female was shot near Gibara, Cuba, on February 24, and a male near Puerto de Tánamo on March 1. Six were taken on Petite Cayemite Island, Haiti, on April 15 and 16, and two on Bug Island, opposite Corail, on April 18.

Family ICTERIDAE, Blackbirds and Troupials

STURNELLA MAGNA HIPPOCREPIS (Wagler)

CUBAN MEADOWLARK

Sturnus hippocrepis WAGLER, Isis, 1838, p. 281 (Cuba).

One was taken near Gibara on February 24.

ICTERUS HYPOMELAS (Bonaparte)

CUBAN ORIOLE

Pendulinus hypomelas BONAPARTE, Consp. Avium, vol. 1, 1850, p. 433 (Cuba).

Four obtained include specimens from near Gibara, February 24, and from the mouth of the Río Moa, opposite Cayo Grande de Moa, March 6.

PTILOXENA ATROVIOLACEA (d'Orbigny)

D'ORBIGNY'S BLACKBIRD

Quiscalus atroviolaceus D'ORBIGNY, *in* La Sagra, Hist. Fis. Pol. Nat. Cuba, vol. 3, Aves, 1839, p. 95, pl. 19 (Cuba).

Two were secured near Gibara on February 21.

HOLOQUISCALUS JAMAICENSIS GUNDLACHII (Cassin)

EAST CUBAN GRACKLE

Quiscalus gundlachii CASSIN, Proc. Acad. Nat. Sci. Philadelphia, 1866, p. 406 (eastern Cuba).

Two were obtained near Gibara on February 24 and 25, and one near the mouth of the Río Moa, opposite Cayo Grande de Moa, on March 6. These are all representative of the east Cuban race.

HOLOQUISCALUS NIGER NIGER (Boddaert)

HISPANIOLAN GRACKLE

Oriolus niger BODDAERT, Table Planches Enl., 1783, p. 31 (Hispaniola).

Skins were forwarded from Montet, near Port au Prince, March 28; from Baradères, April 6; from Petit Trou de Nippes, April 9; and from Île à Vache, April 27.

Family THRAUPIDAE, Tanagers

SPINDALIS PRETREI (Lesson)

CUBAN SPINDALIS

Tanagra Pretrei LESSON, Cent. Zool., 1831, p. 122, pl. 45 ("Brazil"=Cuba).

Three were collected near Puerto de Tánamo on March 2.

PHAENICOPHILUS POLIOCEPHALUS POLIOCEPHALUS (Bonaparte)

GRAY-CROWNED PALM TANAGER

Dulus Poliocephalus BONAPARTE, Rev. Mag. Zool., 1851, p. 178 (Haiti).

The series obtained includes specimens from the Baradères Peninsula, taken on April 7, and from Bigie, April 21.

PHAENICOPHILUS POLIOCEPHALUS CORYI Richmond and Swales

GONAVE PALM TANAGER

Phaenicophilus poliocephalus coryi RICHMOND and SWALES, Proc. Biol. Soc. Washington, vol. 37, Mar. 17, 1924, p. 107 (La Mahotiere, Gonave Island, Haiti).

Five were taken near the western end of Gonave Island on March 21, two being preserved as skins. The type specimen of this race was collected at La Mahotiere on February 19, 1918, by Dr. W. L. Abbott.

PHAENICOPHILUS POLIOCEPHALUS TETRAOPES Wetmore and Lincoln

ÎLE À VACHE PALM TANAGER

Phaenicophilus poliocephalus tetraopes WETMORE and LINCOLN, Auk, 1932, p. 36. (Île à Vache, Haiti).

Three skins were taken on Île à Vache on April 27, including one adult and two immature birds. The adult bird appeared somewhat different from specimens from the main island but the paler coloration that marks the Île à Vache race were so masked in the immature birds that the specimens obtained on the Parish Expedition on first study were identified as the main island form. Mr. Lincoln and I reached Île à Vache fresh from experience with this tanager in the La Hotte region and, suspecting that some difference might exist, we collected a small series on Île à Vache from which we have subsequently described *tetraopes*.

TANAGRA MUSICA (Gmelin)

HISPANIOLAN EUPHONIA

Pipra musica GMELIN, Syst. Nat., vol. 1, pt. 2, 1789, p. 1004 (Hispaniola).

A female was obtained 10 miles east of Baradères on April 6.

Family FRINGILLIDAE, Grosbeaks, Sparrows, and Finches

TIARIS OLIVACEA OLIVACEA (Linnaeus)

YELLOW-FACED GRASSQUIT

Emberiza olivacea LINNAEUS, Syst. Nat., ed. 12, vol. 1, 1766, p. 309 (Hispaniola).

Four were collected near Gibara, Cuba, on February 21. In Haiti one was taken on Gonave Island on March 23; one at Grand-Boucan on April 9; five on Petite Cayemite Island on April 12, 13, 16, and 17; four on Bug Island, opposite Corail, on April 18; and five on Île à Vache on April 30 and May 1 and 2. Skins from the small islands mentioned do not differ from those of Haiti proper.

TIARIS BICOLOR MARCHII (Baird)

MARCH'S GRASSQUIT

Phonipara marchii BAIRD, Proc. Acad. Nat. Sci. Philadelphia, 1863, p. 29 (Jamaica).

A male from Île à Vache, taken on April 30, is similar to speci mens from Haiti.

LOXIGILLA VIOLACEA AFFINIS (Ridgway)

HISPANIOLAN BULLFINCH

Pyhrrulagra affinis "(Baird)" RIDGWAY, Auk, 1898, p. 322 (Port au Prince Haiti).

Two males were collected at the western end of Gonave Island Haiti, on March 21, and one at Thomazeau on April 1.

LOXIGILLA VIOLACEA PARISHI Wetmore

PARISH'S BULLFINCH

Loxigilla violacea parishi Wetmore, Proc. Biol. Soc. Washington, vol. 44, Feb. 21, 1931, p. 27 (Île à Vache, Haiti).

This race, named in honor of Lee H. Parish, is similar in color to *Loxigilla violacea affinis* (Ridgway), but averages smaller in all dimensions, including the bill. It is known only from Île à Vache, where it is said to be fairly common.

Following is a description of the type specimen, together with measurements: Type, male adult, Île à Vache, Haiti, April 30, 1930, collected by S. W. Parish (orig. No. 502). Throat, short line above eye, and under tail-coverts somewhat darker than burnt sienna; axillars and under wing-coverts with a small amount of whitish; plumage otherwise deep black, with a faint wash of deep slate on back. Bill, feet, and tarsi black (from dried skin).

Measurements.—Males, two specimens: Wing, 71.1 [16]–71.5 (71.3); tail, 62.6–62.7 [16] (62.6); culmen from base, 14.7 [16]–14.7 (14.7); depth of bill at base, 11.8 [16]–12.3 (12.1); tarsus 19.7 [16]–20.3 (20) mm. Female, one specimen: Wing, 67.2; tail, 59; culmen from base, 12.9; depth of bill at base, 10.4; tarsus, 18.8 mm.

The smaller size indicated seems constant when compared with a long series of *L. v. affinis* from Haiti (including Gonave Island) and the Dominican Republic, as indicated by the following measurements of birds from the area just indicated:

Fifteen males: Wing, 74.3–79.2 (76.7); tail, 61.7–69.3 (65.3); culmen from base, 14.2–16.5 (15.2); depth of bill at base, 11–12.9 (12.3); tarsus, 19.2–23.4 (21.1) mm. Nine females: Wing, 67.2–75.8 (71.2); tail, 59.8–67 (63.5); culmen from base, 12.6–14.3 (13.6)[17]; depth of bill at base, 10.4–11.8 (10.9); tarsus, 19.7–22.3 (21) mm.

In addition to the skins two birds were prepared as skeletons.

MELOPYRRHA NIGRA (Linnaeus)

CUBAN BULLFINCH

Loxia nigra LINNAEUS, Syst. Nat., ed. 10, vol. 1, 1758, p. 175 (Cuba).

One was secured near Puerto de Tánamo on March 2, and one near the mouth of the Río Moa, opposite Cayo Grande de Moa on March 6.

[16] Type.
[17] Average of eight specimens.

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A NEW SPECIES OF CESTODE—CREPIDOBOTHRIUM AMPHIUMAE FROM AMPHIUMA TRIDACTYLUM

BY

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A NEW SPECIES OF CESTODE, CREPIDOBOTHRIUM AMPHIUMAE, FROM AMPHIUMA TRIDACTYLUM

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An examination of the intestinal contents of *Amphiuma tridactylum* from Louisiana reveals the presence of some cestodes, which are herein described as a new species. I wish to express appreciation to Dr. B. P. Young for suggestions and to Dr. H. D. Reed for the source of material.

After investigating numerous sources of literature, I have been unable to find a record of any cestode previously described from this urodele. Several cestodes have been described from amphibians and reptiles, and in LaRue's monograph (1914) they are included in the family Proteocephalidae, genus *Ophiotaenia.* Woodland (1925) strongly criticizes the characters and system used by LaRue in his part on classification and points out that *Ophiotaenia* has been shown to be synonymous with *Crepidobothrium. Ophidotaenia* (Beddard, 1913) is also shown to be synonymous with the former genus. Meggitt (1927) says that Lühe (1899) has correctly shown that the generic name *Protocephalus*, which has been applied to forms of this group, is invalid. Woodland would base the classification on the relation of the genital organs to the muscle sheath and also would place a large number of species in the genus *Proteocephalus*, with *Crepidobothrium* as a provisional group. The account given by Ward and Whipple (1918) is now somewhat incomplete. Meggitt (1927) gives a tentative system of classification of the group and an excellent summary of the known species. The forms in the genus *Ophiotaenia* are distributed by him among the genera *Crepidobothrium* and *Ichthyotaenia.*

Ophiotaenia has been reported from several urodeles and anurans: *O. filaroides* (LaRue, 1909) from *Ambystoma tigrinum; O. longbergii* (Fuhrman, 1895) from *Necturus maculosus; O. cryptobranchi* (LaRue, 1911) from *Cryptobranchus alleghcniensis*, *O. magna* (Hannum, 1925) from *Rana catesbeiana;* and *O. hylae* (Johnson, 1912) from a *Hyla* from Australia. The characters of the genus *Crepidobothrium* given by Meggitt are as follows:

Genus CREPIDOBOTHRIUM Monticelli, 1900

Generic diagnosis.—Scolex with or without apical organ of various shapes, never with a rostellum armed with hooks. Surface of scolex and suckers sometimes covered with spines. Testes in two lateral fields with an occasional tendency to coalesce anteriorly. Vagina anterior or posterior to cirrus sac, usually with a well-developed sphincter.

Type species.—*C. gerrardi* Baird, 1860.

CREPIDOBOTHRIUM AMPHIUMAE, new species

Specific diagnosis.—*Crepidobothrium:* Length up to 25 cm. Scolices 280μ to 640μ long by 400μ to 480μ wide. Apparently no apical organ is present. Sucker 160μ in diameter. Strobilization is marked in two compressed specimens at 60μ and 180μ from the scolex. The immature proglottids at a distance of 6 mm from the scolex are 300μ long and 720μ to 810μ wide, when prepared with some compression. The mature proglottids (pl. 1, fig. 6) at a distance of 25 cm from the scolex are 800μ to 1.04 mm long and 960μ to 1.52 mm wide. The ripe, or gravid, proglottids (pl. 1, figs. 7, 8) are 1.6 mm to 1.9 mm wide and 4.4 mm to 4.6 mm long. The genital pore is in the anterior fifth of the gravid proglottid. There is a common sinus for the openings of the cirrus sac and vagina. The genital opening alternates irregularly. The cirrus is frequently protruded. (Pl. 1, fig. 4.) The cirrus is unarmed. The cirrus pouch is 320μ to 490μ long and 80μ to 160μ wide. The genital ducts lie between the excretory ducts. The vas deferens consists of three coils within the cirrus pouch and several outside. Testes are about 50 to 70 in number, in each field on both sides of the uterus with a few approaching the midline. The vagina is always anterior to the cirrus pouch; it does not cross the pouch and is without convolutions. The ovary in the ripe proglottid has an anterior-posterior length of 830μ. There are about 50 to 65 uterine pouches on each side. A uterine pore is present in the posterior part of the proglottid.

Host.—*Amphiuma tridactylum.*

Location.—Middle intestine.

Distribution.—Louisiana.

Type specimen.—U.S.N.M. Helm. Coll. No. 8118.

Remarks.—*Crepidobothrium amphiumae* as just described falls within group E of the genus according to Meggitt (1927), because of the number of uterine diverticula (100 to 130), which exceeds 25, and the number of testes (100 to 140). *C. lonnbergii* has approximately the same number of testes, but the vagina and cirrus alternate in position, the uterine diverticula are less, and an apical organ is present.

C. cryptobranchii also falls within this group (E) but has not been placed there by Meggitt because the description was lacking. It differs from the one described in the alternating position of the vagina and the smaller number of uterine diverticula. There is a close similarity to *Ichthyotaenia filaroides*, but the number of uterine diverticula, measurements, and apex of the scolex are points of differentiation. *C. magnum* has the genital pore located between the first and middle third of the segment, less uterine diverticula, and the vagina anterior or posterior to the cirrus pouch. *Ichthyotaenia hylae* has the vagina anterior to the cirrus pouch, but the number of the testes and uterine diverticula is less.

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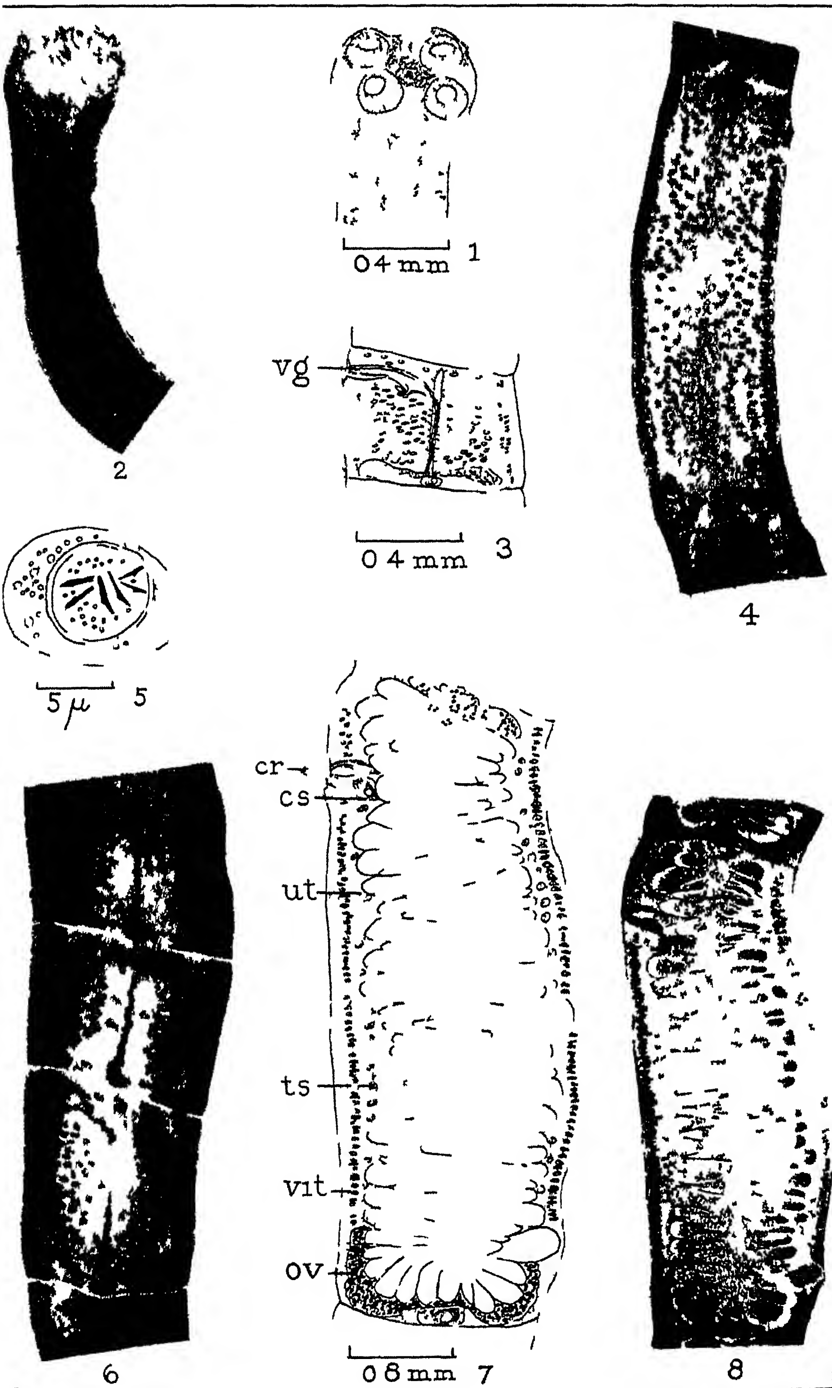

CREPIDOBOTHRIUM AMPHIUMAE NEW SPECIES

1 Scolex 2 Scolex × 28 3 mature segment from the anterior part of the worm 4 nearly ripe proglottid with cirrus protruded × 15 5 egg containing the onchosphere 6 mature proglottid × 28 7 ripe proglottid 8 ripe proglottid × 15

THE MARINE AND FRESH-WATER SPONGES OF CALIFORNIA

BY

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THE MARINE AND FRESH-WATER SPONGES OF CALIFORNIA

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Pasadena, Calif.

INTRODUCTION

The sponges of the western coast of the United States have been very little studied, although they exist in profusion and comprise a large variety of interesting forms. One hundred and one species are discussed in the following pages, and six of these (*Polymastia pachymastia*, *Hymeniacidon ungodon*, *Zygherpe hyaloderma*, *Plocamia igzo*, *Halichoclona gellindra*, and *Spongia idia*) are described for the first time. In addition, three genera and five varieties are described as new. In order to render this paper of use to those who are not specialists as well as to specialists, all species that I have been able to find in California are described, whether they be new or old. Briefer reference is made to those forms that are to be found only in the literature on the subject.

California's length of more than 1,400 kilometers exceeds the distance from New York to Florida and that from Denmark to the Mediterranean, and depths of more than 1,500 meters are reached within 20 to 60 kilometers offshore. A great variety of species of sponges is to be expected within such limits. In addition to those treated herein, many species are to be looked for in the deeper waters offshore, as well as other shallow-water forms from the northern part of the State. Most of the present marine biological investigation, however, is being carried on off the central and southern coasts, and it is believed that the species of those waters are herein rather thoroughly covered.

I have personally searched the intertidal areas rather carefully, have had much dredged material representing the central-California region presented to me by E. F. Ricketts, and have studied the extensive collection dredged off southern California during the years 1909 to 1927 by the University of Southern California. (See Figure 1 for map of localities mentioned in this report.)

Much of the preparation of this paper was carried on at the British Museum (Natural History) in London, and special gratitude is expressed to Maurice Burton, of that institution, for cooperation kindly extended. To the officials of the United States National Museum, grateful acknowledgment also is made for the loan of specimens for study and for literature otherwise inaccessible.

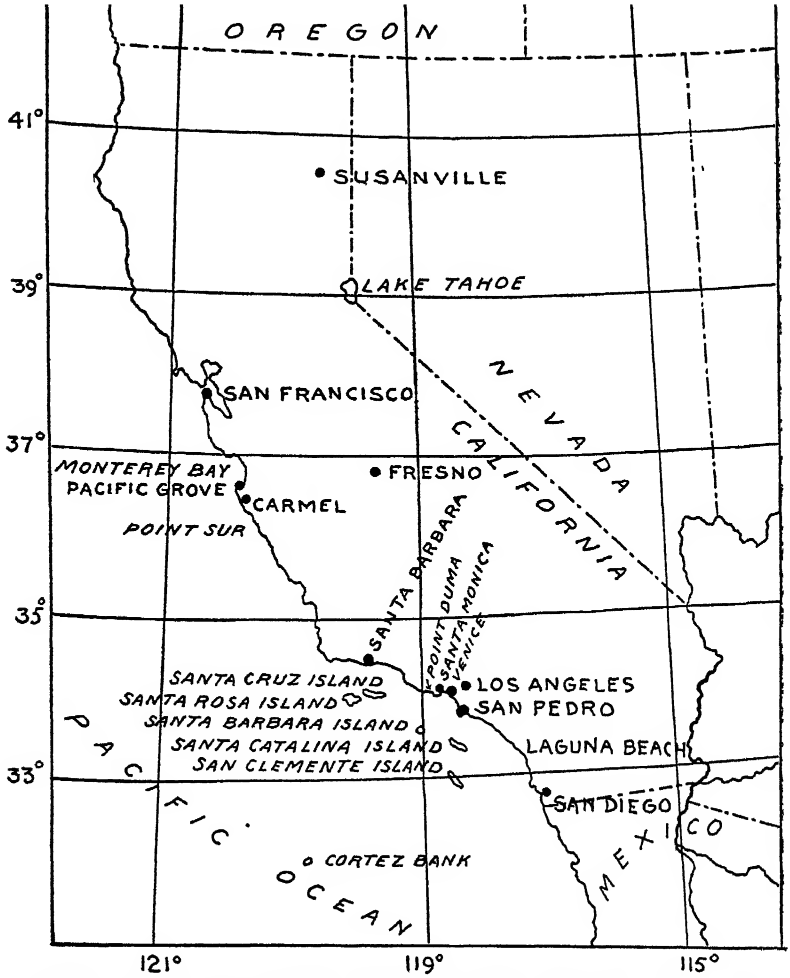

FIGURE 1.—Sketch map showing California localities mentioned in text of this report

So far as possible, representative and type specimens or a portion of these have been deposited in the United States National Museum in Washington (U.S.N.M.) and in the British Museum (Natural History) in London (B. M.), and, unless otherwise indicated, the descriptions given are based on the material so referred to. Under the headings "Type locality" and "Material examined" will be found notes upon the occurrence and habit of the species.

All drawings were made with the aid of a camera lucida unless otherwise indicated.

HISTORICAL SUMMARY

Very little has been published on sponges in or from California. Search of the literature yields 10 references, as follows:

The first is by E. Haeckel, 1872, Die Kalkschwämme. In volume 2 of this monograph of the calcareous sponges of the world, as taken up more fully in the descriptive portion of this paper, he described *Ascilla* (now *Leucosolenia*) *convallaria* (p. 45), *Sycandra* (now *Sycon*) *coronata* (p. 305), and *Leucetta* (now *Leuconia*) *sagittata* (p. 125) merely as from California, "Brown." These species can not now be located in this State.

Fifteen years later E. Potts, 1887, in his monograph on Fresh-water Sponges, described *Meyenia* (now *Ephydatia*) *robusta* (p. 225) from Honey Lake Valley, near Susanville in northeastern California. This species has been found again only once, this time by Annandale (1907, p. 24), who recorded it from Bhim Tal, in the mountains of northern India, at 1,350 meters, almost the same altitude as that of the California specimen.

Lendenfeld (1889, p. 258) named *Euspongia hospes* from Africa and California (which may be Lower California, Mexico). The species is not recognizably described, being characterized merely as growing inside of mollusk shells, taxonomically a relatively insignificant description.

The fourth reference is by L. Lambe, 1894, Sponges from the Western Coast of North America. He reported (p. 124) finding a sponge, which he called *Plocamia manaarensis* (Carter), from California. He did not know the locality within the State, and his identification was incorrect, as explained later in this paper.

The next reference to California sponges is by F. E. Schulze, who in 1899 published his Amerikanische Hexactinelliden nach dem Materiale der Albatross-Expedition, in which he described 14 species from California, as discussed hereafter. He cited as from California, however, four additional species from other localities, as shown by the data, including the latitude and longitude, of the *Albatross* stations involved. Two are from the State of Washington: *Acanthosaccus tenuis* (p. 66) and *Farrea aculeata* (p. 69); and two are from Lower California, Mexico: *Farrea ocea* (p. 68) and *Bathyxiphus subtilis* (p. 82).

Then there were published two articles by F. Urban. In 1902 in the Zeitschrift für Wissenschaftliche Zoologie, he described *Rhabdodermella nuttingi*, which had been sent him by the late Prof. C. C. Nutting, of the University of Iowa; and in 1905 in the Archiv für Naturgeschichte, he described *Leucosolenia eleanor* (p. 36),

Sycandra (now *Sycon*) *coacta* (p. 55), *Leucandra* (now *Leuconia*) *heathi* (p. 59), *Leucandra* (now *Leuconia*) *apicalis* (p. 67). These were sent him from Monterey Bay by Prof. Harold Heath, of Stanford University.

Lendenfeld, in his large monograph on The Geodidae, described in 1910 the following from California: *Sidonops angulata* (p. 24), *S. bicolor* (p. 46), *Geodia mesotriaena* (p. 96), *G. agassizii* (p. 113), *G. mesotriaenella* (p. 151), *G. breviana* (p. 155), *G. ovis* (p. 161), and *Geodinella robusta* (p. 205). Many of these, because of the unjustifiably fine distinctions drawn, have proved to be identical and must hence be regarded as synonyms.

Finally, in 1926, I described three species: *Gellius textapatina*, *Esperella fisheri*, and *Suberites gadus;* and in 1927 three more: *Acarnus erithacus*, *Plocamia karykina*, and *Plocamia* (better *Isociona*) *lithophoenix;* with a redescription of *Desmacella* (better *Ophlitaspongia*) *pennata* Lambe, 1894. So far as I am able to ascertain, this is a complete list of references to sponges from California. Reference is made to the Bibliography, page 128, for complete citations to the papers mentioned.

PREPARATION OF ALCOHOLIC MATERIAL FOR STUDY

Identification of sponges depends upon miscroscopic characteristics, for it is utterly impossible to rely upon macroscopic features alone. This need not unduly discourage attempts to identify species, as it is possible to prepare a sponge for examination in about 10 minutes, especially if the material has already been hardened in alcohol.

Take a small portion (less than 1 cubic centimeter) that includes some of the outer surface of the sponge, and place it on a clean slide. With a sharp razor (a safety-razor blade will do), section the material, if possible, both perpendicularly to the surface and tangentially. In a surprisingly large number of cases, this will be found to be possible; however, if only fragments can be obtained, they can still serve. The sections or fragments should be less than 0.5 mm, but may be nearly that thick to good advantage. Flood the material with a few drops of absolute alcohol, dry with paper towel or blotting paper, and repeat from one to three times as necessary to dehydrate. Add a few drops of carbol xylene and again blot dry to complete the dehydration thoroughly. Add a few drops of xylene to complete the clearing and, without drying more than slightly, add some very stiff balsam and cover slip. A little stain, such as basic fuchsin, may be added to the alcohol to advantage. Comparison of slides thus made with illustrations as given herein should make identification possible in most instances.

GENERAL CLASSIFICATION

Students of sponges do not agree as to methods for classifying them. One of the most recent and best of myriad systems is that of Topsent (1928), which roughly is the source of the arrangement herein employed. For the phylum Porifera Topsent employs 11 orders without diagnosing them. The following represents an attempt to describe these orders (except one that has been dropped) in a manner convenient for students who have not specialized at all in the systematics of sponges, although for proper taxonomy such descriptions are unsuitable:

1. **Calcarea:** Sponges with calcareous skeletons; this may be tested with acid, as calcium carbonate dissolves in most of the common acids, but silica only in hydrofluoric acid. The normal inorganic skeletal material in the other orders is siliceous.

2. **Hexactinellida:** Sponges whose principal spicules have five or six rays diverging from a central point. Such spicules may occur as small or auxiliary spicules in the other orders, but not as chief spicules.

3. **Myxospongida:** Sponges with no skeleton whatever, neither fiber nor spicule; sometimes called "slime sponges." It is not known whether they are primitive or degenerate, but probably they are the latter. They may possibly be derived from more than one of the other orders.

4. **Choristida:** Sponges typically with tetraxons among their principal spicules, often having a conspicuously radiate structure and a cartilaginous rind, or ectosome.

5. **Hadromerina:** Sponges often with pin-shaped spicules (tylostyles), asters as microscleres, corticate ectosome, and radiate structure. Almost any sponge lacking tetraxon spicules and having any two of these features should be put in this order.

6. **Halichondrina:** This order is very difficult to describe to the nonspecialist. In general, there is very confused arrangement of spicules, together with simplicity of spiculation. Very few members of this group have any microscleres, and, if any, they are few and simple.

7. **Poecilosclerina:** Almost all the sponges that have any one of the following characteristics belong here: (*a*) Larger spicules spiny; (*b*) chelas as microscleres; (*c*) fibers containing monactinal spicules. If there is any possibility that the sponge for which identification is sought belongs in this order, try that assumption hopefully, as many more sponge species are assigned to this order than to any other.

8. **Haplosclerina:** Sponges with only diactinal chief spicules and with only very simple microscleres, if any; they are usually markedly

reticulate in plan. It will be observed that this order, by definition, approaches close to some members, at least, of both the two preceding orders. The fresh-water sponges might be placed here or in the preceding group as a unit. Topsent does not discuss them in his 1928 article proposing the classification here considered.

9. **Dictyoceratina:** Sponges with no proper spicules (some from other sponges may become included as the sponge grows) but with a decided reticulation of spongin fibers.

10. **Dendroceratina:** Sponges with no proper spicules (see note above) but with spongin fibers that branch and do not reunite, resembling little trees in form.

Topsent regards the first of these orders as also a class, the second order as a second class, and the rest as a third class.

SYSTEMATIC DISCUSSION

Order CALCAREA Gray

Family LEUCOSOLENIIDAE Minchin

Genus LEUCOSOLENIA Bowerbank

LEUCOSOLENIA CONVALLARIA (Haeckel)

Ascilla convallaria HAECKEL, 1872, vol. 2, p. 45.
Leucosolenia convallaria DENDY and ROW, 1913, p. 725.

Holotype.—Location unknown.

Type locality.—Described from the Pacific coast of North America (California, Brown). The species has not since been found in the State.

Description.—Hollow cylinders 0.05–0.1 mm thick, 2–4 mm long. Fragile, white, surface minutely hispid. The wall of the tube is of simple ascon type, strengthened by usually two layers of quadriradiates only, of which the apical ray is from two-thirds to as long as each of the facial rays.

Remarks.—Ascon type sponges with only quadriradiates are very rare. Hozawa (1929, p. 285) described a very similar one, *Leucosolenia kagoshimensis*, from Kagoshima Bay, Japan, and Haeckel (1872, vol. 2, p. 47) described another, *Leucosolenia* (*Ascilla*) *japonica*, also from Japan.

LEUCOSOLENIA MACLEAYI Lendenfeld

Leucosolenia macleayi LENDENFELD, 1885, p. 1086.
Leucosolenia stipitata DENDY, 1891, p. 51.

Holotype.—Location unknown.

Type locality.—First described from Australia.

Material examined.—About a dozen specimens were studied, all collected near Laguna Beach, intertidal, March 14, 1926, by myself. They were found principally pendant on the underside of sandstone bowlders.

Description (U.S.N.M. No. 21464; B.M. No. 29.8.22.49).—Shape, clathrous, vasiform, pedunculate. Size, up to 4 mm in diameter, 8 mm in height. Consistency, fragile. Color in life and when preserved, white. Oscules, few and simple; diameter, 70μ. Pores, minute; diameter, about 5μ. Surface, superficially smooth, microscopically hispid.

Ectosomal specialization, none. Endosomal structure, ascon tubes 80μ to 130μ in diameter, branching and anastomosing to make a reticulation with meshes 70μ to 270μ in diameter. The skeleton consists of about two layers of simple triaxons. Histological details: I have

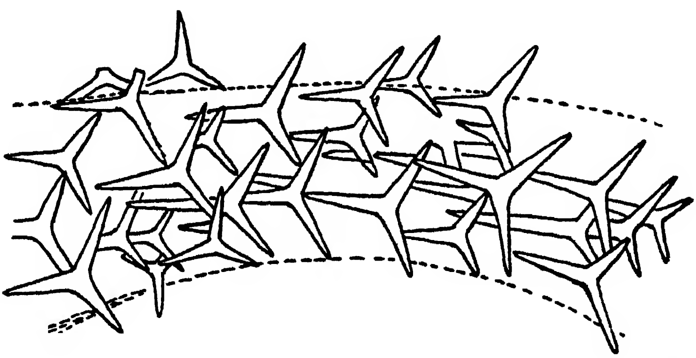

FIGURE 2.—*Leucosolenia macleayi* Dendy: One of the ascon tubes, ×300; illustrating the spicules and their placement

a preparation of this species in which the axial canals of the spicules are clearly evident. This is rather uncommon in calcareous spicules. Statements have even been made that calcareous spicules lack such an axial canal, although Minchin (1900, p. 40) calls attention to the fact that there really is one.

Principal spicules, triaxons (fig. 2). Size of each ray, 3μ by 40μ to 6μ by 60μ; the usual size is 6μ by 40μ.

Remarks.—There are rather few Leucosolenias having only triradiates, but some of these, including the present species, are common and nearly cosmopolitan. *L. macleayi* is characterized by delicate lacy form, regularity, and simplicity of spiculation, and by the stipitate habitus. I wish to thank Maurice Burton, of the British Museum of Natural History, for help in allocating this species, as by a mistake I had identified it with the rather similar *Leucosolenia coriacea* Montagu. *L. coriacea* differs in that it always has more repent form than *macleayi.*

LEUCOSOLENIA ELEANOR Urban

Leucosolenia eleanor URBAN, 1905, p. 36.

Holotype.—In the possession of Prof. F. Urban, Marienbad, Czechoslovakia.

Type locality.—Monterey Bay.

Material examined.—Abundant California specimens. I find this species only in the vicinity of Monterey Bay, where it is very common intertidally. It occurs on the underside of granite bowlders or underneath protrusions of rock, often where the surf breaks on it.

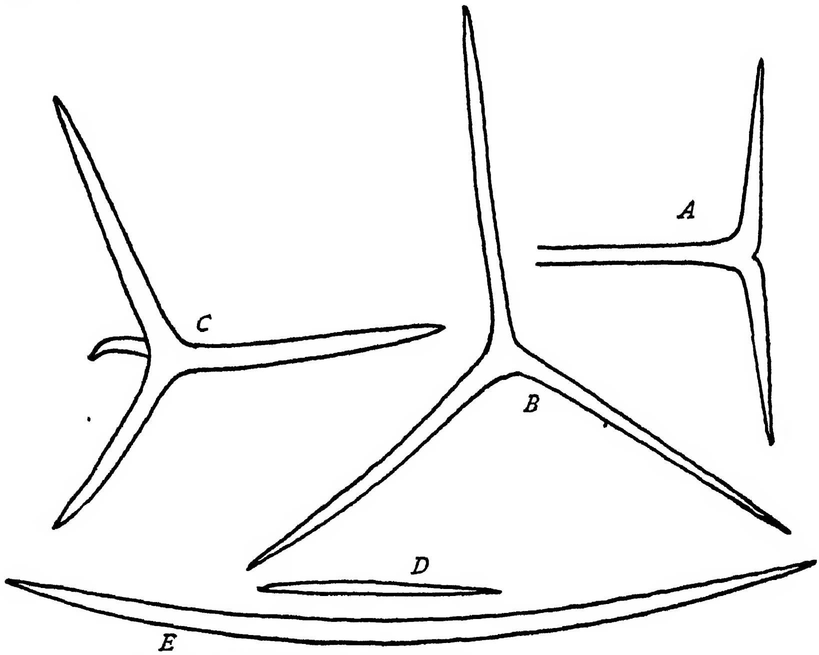

FIGURE 3.—*Leucosolenia eleanor* Urban: Triradiates (*A*, *B*) and quadriradiates (*C*) of average size, and extremes of the oxeas (*D*, *E*), ×300

Description (U.S.N.M. No. 21465; B.M. No. 29.8.22.46).—Shape, clathrate masses of branching and anastomosing tubes. Size, up to 10 cm in diameter; the tubes are 0.3–1.7 mm in diameter. Consistency, fragile, slightly spongy. Color in life and when preserved, white. Oscules, simple, few, approximately 1 mm in diameter. Pores, minute, abundant. Surface, superficially smooth.

Ectosomal specialization, none. Endosomal structure, typically ascon. It is remarkable that although clathrate there are no blind diverticulations, the number of oscules increasing as the size of the colony increases. That which is now regarded as the genus *Leucosolenia* was formerly divided into two genera, the second called *Clathrina*, the basis of separation being the absence or presence of

clathrate form, and the fact that in the latter there were not only many blind diverticulations, but the number of oscules did not increase with enlargement of the colony; *eleanor* is precisely intermediate between the two. Histological details: The nuclei of the collar cells are sometimes placed basically, sometimes apically, according to Urban.

First type of spicules, oxeas (fig. 3, *D* and *E*); size, 4μ by 105μ to 9μ by 434μ. Second type of spicules, quadriradiates (fig. 3, *C*); size of rays, about 9μ by 140μ. Third type of spicules, sagittal alate triradiates (fig. 3, *A*); size of rays, about 7μ by 80μ. Fourth type of spicules, regular triradiates (fig. 3, *B*); size of rays, about 7μ by 140μ.

Remarks.—There does not seem to be any other *Leucosolenia* very close to *eleanor*, although, of course, many species of this genus have much in common with it. Most characteristic is the extent to which it is intermediate between the characteristics formerly assigned to *Clathrina* and those always assigned to *Leucosolenia.*

LEUCOSOLENIA NAUTILIA de Laubenfels

Leucosolenia nautilia DE LAUBENFELS, 1930, p. 25.

Holotype.—U.S.N.M. No. 21466; B.M. No. 29.8.22.11.

Type locality.—A small group of California specimens was studied, all collected by myself, July 20, 1926, from the bottom of a motor-driven fishing vessel that had been in active use near Monterey Bay since its previous cleaning, about six months earlier. This sponge was here associated with the introduced mussel, *Mytilus edulis*, a remarkable circumstance. The only mussel at all common locally is *M. californianus.*

Description.—Shape, there is a stoloniferous basal reticulation from which rise separate tubes. Size of largest colony, 20 mm high, 35 mm in diameter. Tubes, 0.2–2 mm in diameter and about 20 mm long; walls, about 50μ thick. Consistency, fragile. Color in life and when preserved, white. Oscules, apical; diameters, as for the tubes. Pores, about 50μ in diameter; they cause the walls of the tubes to appear fenestrated. Surface, superficially hispid.

Ectosomal specialization, none. Endosomal structure, typical ascon sort. Histological details: The nuclei of the collar cells are so located in the main body of the cell as to be dubiously basal.

First type of spicules, large oxeas (fig. 4, *A*), size, 10μ by 400μ to 20μ by 1,000μ. Second type of spicules, small oxeas (fig. 4, *D* and *E*); size, about 4μ by 140μ. Third type of spicules, triradiates (fig. 4, *B*); size of rays, about 9μ by 140μ. Fourth type of spicules, quadriradiates (fig. 4, *C*); size of projecting rays, about 8μ by 30μ, tangential rays as for the triradiates.

Remarks.—The most abundant spicules seem to be the oxeas, which are commonly about 600μ to 800μ long but sometimes more than 1 mm. They are typically nearly tangential, but not quite, the distal fourth or third hispidating the surface. Smaller ones occur among them. The triradiates are between them and the gastral layer. The gastral (or cloacal) layer is packed with autogastral quadriradiates, the projecting ray comparatively short. The choanocytes are arranged on this inner surface only, as typical of ascons, and their nuclei are centrally located within the mass of the cell.

This species comes very close to the genus *Ascute*, which has the large oxea entirely embedded within the flesh. Its genotype, *A. uteoides* Dendy (1893, p. 178), from Australia, has besides this difference the further ones of lacking triradiates and having oxeas

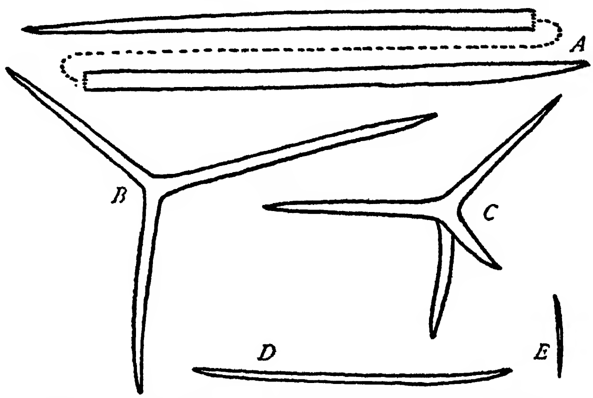

FIGURE 4.—*Leucosolenia nautilia* de Laubenfels: Extremes of size for the small oxeas (*D, E*) and average sizes for the other spicule sorts (*A, B, C*), ×300

twice as thick though not much longer; nevertheless, I regard it as fairly closely related to *nautilia*, as other items are very similar. There is some possibility that the numerous differences from *Leucosolenia eleanor*, the common local intertidal member of this genus (p. 8), may be accounted for by the peculiar ecological placement of *nautilia*. There seems to be no other record of calcareous sponges fouling boat bottoms. Neither mussels nor sponges occur at all commonly on the bottoms of the fishing boats around Monterey Bay.

Family SYCETTIDAE Dendy

Genus SYCON Risso

SYCON COACTUM (Urban)

Sycandra coacta URBAN, 1905, p. 55.
Sycon coactum DENDY and ROW, 1913, p. 745.

Holotype.—In the possession of Prof. F. Urban, Marienbad, Czechoslovakia.

Type locality.—Monterey Bay, Calif. I have not succeeded in finding this species in the field, in spite of very careful search in the type locality.

Description.—This is a noncolonial, flask or vase-shaped sponge, about 5 mm in diameter and 6 mm high. The color is white. There is an erect oscular crown. The chamber system is of the second type (sycon). There are oxea of the oscular fringe, size 3μ by 500μ to 10μ by 500μ, and of the choanosome, size 35μ by 1,000μ and less, and microxeas about 2μ by 40μ in the walls of the radial tubes and pseudogastral layer. The latter two locations are also supplied with triradiates and quadriradiates, rays about 10μ by 90μ. The triradiates are usually sagittal.

Remarks.—Urban fails to explain how this differs from the numerous other Sycons or Sycandras. It seems to differ from *Sycon coronatum* in its microxea and in the lack of dermal tufts over the distal ends of the radial tubes.

SYCON CORONATUM (Ellis and Solander)

Spongia coronata ELLIS and SOLANDER, 1786.
Grantia ciliata BOWERBANK, 1864, according to HAECKEL, 1872.
Sycandra coronata HAECKEL, 1872.
Sycon coronatum DENDY, 1892.

Holotype.—Location unknown.

Type locality.—Europe. Haeckel (1872, vol. 2, p. 305) lists this species as from California, Brown. The species is cosmopolitan, but I have not found it in California.

Description.—This is a single cylindrical individual (noncolonial), usually 3 mm by 10 mm to 7 mm by 30 mm in diameter and height. Unless soiled it is white. The canal system is of the second, or sycon, type. There are many triradiates and quadriradiates, both regular and sagittal or alate; the single rays are often 0.007 mm by 0.14 mm in size. There are large oxea (about 0.02 mm by 1 to 2 mm) in tufts on the surface, particularly over the outer ends of the lateral diverticula of the pseudogastral cavity. The oscule is crowned with an erect spicular fringe.

Family GRANTIIDAE Dendy

Genus LEUCONIA Grant

LEUCONIA SAGITTATA (Haeckel)

Leucetta sagittata HAECKEL, 1872, p. 125.
Leucandra sagittata DENDY and ROW, 1913, p. 774.

Holotype.—Location unknown.

Type locality.—Pacific coast of North America (California, Brown).

Description.—A mass of branching and anastomosing tubes 35

by 70 mm in size, with oscula much fewer than the total number of tubes. The color in alcohol is given as brown. The tubes are mostly 3 mm thick but vary from about 2 to 5 mm, with walls 0.4 to 0.8 mm thick. The surface is smooth both inside and out. Canal system leuconoid. The skeleton is of triradiates only, the largest having rays up to 0.06 by 0.8 mm, others are as small as 0.01 by 0.1 mm. All or nearly all are decidedly alate.

Remarks.—No one seems to have found another specimen of this sponge since Haeckel described it.

This genus has been quite generally known as *Leucandra;* but, as Burton (1929, p. 403) points out, the name *Leuconia* Grant, 1833, has clear priority and should never have been dropped for *Leucandra* Haeckel, 1872.

LEUCONIA HEATHI (Urban)

Leucandra heathi URBAN, 1905, p. 59.
Leucandra apicalis URBAN, 1905, p. 67.

Holotype.—In the possession of Prof. F. Urban, Marienbad, Czechoslovakia.

Type locality.—Monterey Bay, Calif.

Material examined.—Numerous California specimens were studied. The species is abundant near Monterey Bay, occurring on and under granite bowlders near low-tide mark. In southern California, one finds what I take to be the same species, but so far only small and misshapen specimens. I found one intertidal at Laguna Beach in October, 1925. Other specimens were dredged by the University of Southern California on July 19, 1924, in 78 meters off Catalina Island, and on September 26, 1925, in 29 meters near Long Beach (U.S.N.M. No. 21422).

Description (material from type locality, U.S.N.M. No. 21462; B.M. No. 29.8.22.39).—Shape, pyriform, if not crowded, otherwise distorted. Size, up to at least 9 cm high, 11 cm in diameter. Consistency, mediocre. Color in life and when preserved, basically white but usually dirty. Oscules, apical and usually but one to a sponge. Diameter, up to 10 mm. Pores, about 20μ in diameter. Surface, superficially hispid.

Ectosomal specialization, none, aside from the spicule plush. Endosomal structure, leucon type. Histological details: Flagellate chambers 45μ to 85μ diameter.

First type of spicules, coronal oxeas (fig. 5, *E*); size, 4μ by 8,000μ to 12μ by more than 10,000μ. Second type of spicules, large oxeas (fig. 5, *G*); size, 30μ by 3,400μ to 150μ by more than 5,000μ. Third type of spicules, sagittal triradiates (fig. 5, *A*); size of rays, about 10μ by 140μ. Fourth type of spicules, endosomal triradiates (fig. 5, *B*, *C*, and *D*); size, up to 10μ by 225μ. Microscleres, microxeas (fig. 5, *F*); size, about 4μ by 140μ.

The large oxeas are radially placed in the sponge mass and echinate the most of the exterior surface. The sagittal triradiates line the upper cloacal surface. The endosomal triradiates occur frequently in all sizes from the maximum down. The microxeas are located sparsely throughout the sponge.

Remarks.—A noteworthy feature is the sphincter (glistening white) around the upper end of the cloaca, which latter is often quite a third of the diameter of the entire sponge and reaches nearly to the base. Professor Heath tells of finding specimens exposed at

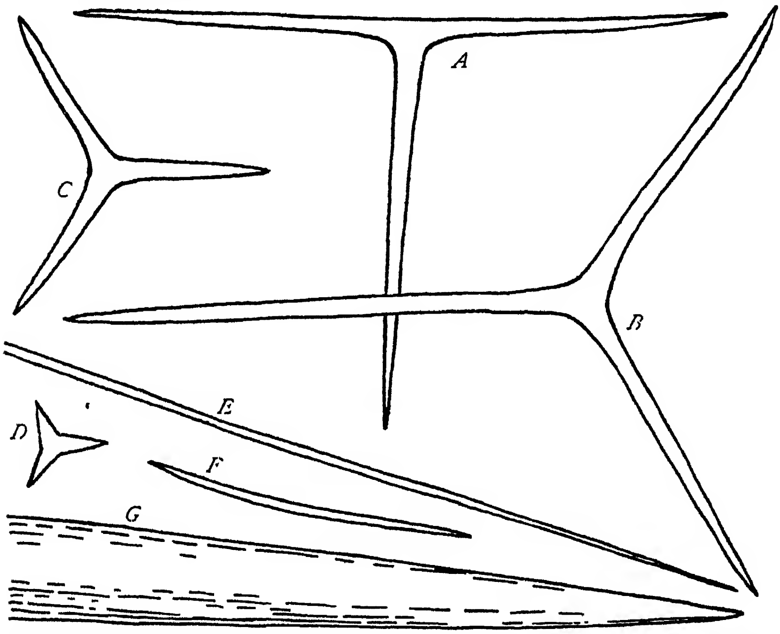

FIGURE 5.—*Leuconia heathi* (Urban): Spicule varieties, ×300; only the terminations of the longer oxeas are shown

low tide, of blowing tobacco smoke at their open oscules, and watching the moderately quick closing by the sphincter. Urban writes of a pore membrane for closing the afferent openings.

In describing *L. apicalis*, Urban fails to cite means whereby it may be distinguished from *L. heathi* of the same locality; therefore I consider it a synonym of *L. heathi.*

Family LEUCASCIDAE Dendy

Genus LEUCETTA Haeckel

LEUCETTA LOSANGELENSIS (de Laubenfels)

Leuconia losangelensis DE LAUBENFELS, 1930, p. 25.

Holotype.—U.S.N.M. No. 21463; B.M. No. 29.8.22.40.

Type locality.—Laguna Beach, Calif., October, 1925, intertidal, collected by the author. Numerous California specimens were

studied, all from southern California. The species is abundant at this locality. In September, 1925, I found it on pilings of a wharf at Venice, Calif. The University of Southern California collected it twice in July, 1914, without locality record, at Whites Point (near San Pedro) without date record (U.S.N.M. No. 21407), and on July 13, 1923, at Point Vincente (near San Pedro) (U.S.N.M. No. 21402). The species occurs in a variety of situations throughout the lower half of the intertidal zone, seeming to favor situations in the bottom of crevices and where the wave action is strong. It is much infested with other animals, particularly crustaceans.

Description.—Shape, amorphous. Size, up to about 2 cm thick and 10 cm in diameter. Consistency, mediocre. Color in life and when preserved, white to pale brown. Oscules, oval, scattered, size about 1 by 3 mm. Pores, not superficially evident. My sections show them definitely closed with a distinct pore-membrane about 5μ to 20μ thick. They lead to canals a little more than 100μ in diameter so probably can be opened to about that size. Surface, superficially smooth, contort, with lumps and ridges several millimeters high.

Ectosomal specializations, dermal membrane, 5μ thick; not detachable, fleshy, contains abundant nuclei. Below it is a zone about 115μ thick devoid of flagellate chambers, containing amoebocytes often elongate and perpendicular to the surface, in a ground substance (collenchyma) appearing noncellular, probably protoplasmic. Endosomal structure, leuconid, arranged very much as in many of the Demospongias. It is quite remarkable that this calcareous sponge so closely resembles in shape an amorphous noncalcareous sponge. The surface is often ridged, or again it may be merely irregularly lumpy. The oscules are scattered here and there. From them canals meander through the choanosome, all in quite halichondrine fashion. I have found small specimens scarcely more than a centimeter in diameter, and even they had two or three small oscules and none of the characteristic symmetry of the Calcarea. It would be most interesting to find still younger forms and trace the early stages. Histological details (besides those mentioned above): The flagellate chambers are usually oval, extreme measurements about 30μ to 80μ.

First type of spicules regular triaxons (fig. 6, *C*, *D*, and *H*); second type of spicules, sagittal triaxons (fig. 6, *F*).

The characteristic spiculation of this species is a confused tangle of two sizes of triaxons, the larger (fig. 6, *C*) with rays about 40μ by 400μ, the smaller (fig. 6, *E*) with rays about 13μ by 130μ. Some specimens, including the type specimen, contain numerous intermediates, but in many specimens the distinction into two different sized ranges is conspicuous. Careful study of many specimens yields the following as supplementary remarks: In two instances I have found a small fourth ray on a spicule (fig. 6, *G*); this item is so rare that

I doubt if quadriradiates should be cited as of normal occurrence. In a few cases I have found small oxeas near the surface (fig. 6, *A*). These are not certainly proper. Rather more often I find microtylostyles about 5μ by 40μ (fig. 6, *B*). I interpret these as essentially triradiates, with two rays almost entirely suppressed. In some parts of some specimens I find curious microspined cylinders, about 3μ in diameter, of variable lengths, with abrupt ends (fig. 6, *H*). It seems doubtful that they are proper spicules, or even

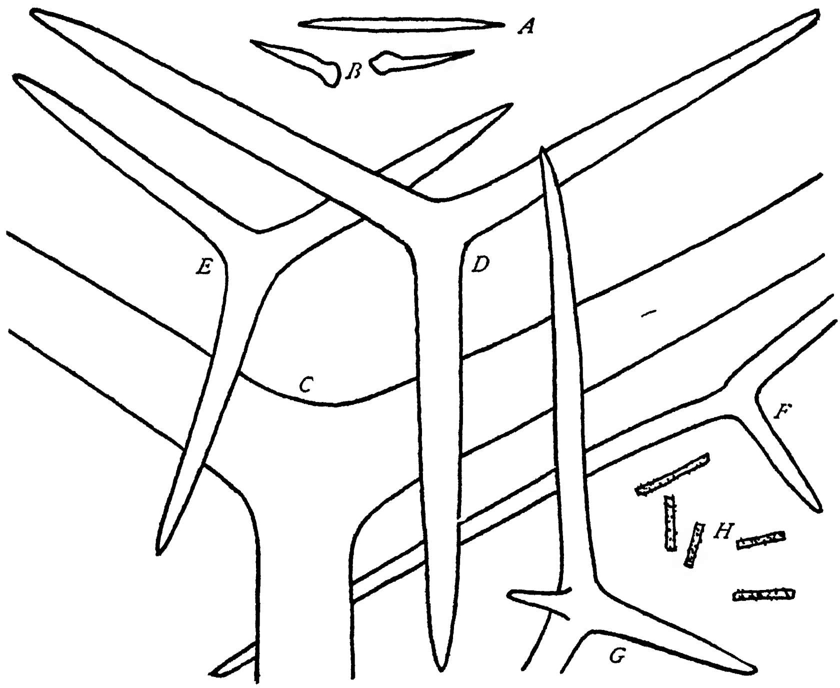

FIGURE 6.—*Leucetta losangelensis* (de Laubenfels), spicules, ×300

spicules at all; but they should be mentioned. Some of the triradiates are both alate and sagittal, these being, as usual, around the oscules.

Remarks.—The species closest here would seem to be that described by Hozawa, 1929, as *Leucandra solida.*

Family AMPHORISCIDAE Dendy

Genus RHABDODERMELLA Urban

RHABDODERMELLA NUTTINGI Urban

Rhabdodermella nuttingi URBAN, 1902, p. 268.
Leucilla nuttingi DENDY and ROW, 1913, p. 784.

Holotype.—In the possession of Prof. F. Urban, Marienbad, Czechoslovakia.

Type locality.—Monterey Bay, Calif.

Material examined.—Numerous California specimens were studied. The species is very common in the intertidal zone both in southern California and the Monterey region; and E. F. Ricketts reports seeing sponges resembling this at various intermediate points. The University of Southern California dredged it in 27 meters off Long Beach. It often hangs from the underside of bowlders, and as exposed at low tide makes beautiful pearllike pendants.

Description (U.S.N.M. No. 21486; B.M. No. 29.8.22.43).—Shape, vasiform, elongate, stipitate. Size, up to 5 mm in diameter, 25 mm high. Consistency, mediocre. Color in life and when preserved, white. Oscules, apical; diameter up to 3 mm. There is a small

FIGURE 7.—*Rhabdodermella nuttingi* Urban: Spicules (limits of protoplasmic structures indicated by dotted lines) in a cross section perpendicular to the long axis of the sponge, the various sorts except the coronal oxeas in situ, ×95. The upper portion of the figure is the external, the lower is the cloacal

coronal palisade of erect spicules. Pores, up to 200μ in diameter. Surface, superficially smooth.

Ectosomal specialization, the dermis (20μ thick) contains distinctive microrhabds, placed vertically, in great abundance. Endosomal structure, leuconid of the sort termed sylleibid, that is, with the flagellate chambers in grape-cluster arrangement. Histological details: The flagellate chambers are oval, about 70μ by 126μ in size.

First type of spicules, coronal oxeas (not figured); size about 25μ by 1,250μ. Second type of spicules, large hypodermal quadriradiates or triradiates (fig. 7, *A*); size of rays, about 40μ by 875μ. Third type of spicules, smaller triradiates (fig. 7, *B*); size of rays, about 10μ by 230μ. Fourth type of spicules, very small quadriradiates or triradiates (fig. 7, *C*); size of rays, about 4μ by 20μ to 5μ by 100μ. Microscleres, microxeas (fig. 7, *D*); size, about 2μ by 45μ.

The coronal oxeas are arranged in a palisade about the oscule, as usual. The large quadriradiates or triradiates are hypodermal. Their rhabds reach clear to the gastral layer, the cladome being near the outer surface. The smaller triradiates are scattered in the choanosome. The still smaller quadriradiates or triradiates line the gastral surface. The fourth ray, or in the case of the triradiates, one of the three, is autodermal.

Remarks.—Dendy and Row in monographing the Calcarea (1913, p. 793) put this in the large genus *Leucilla.* The type species of that genus, *L. amphora,* is somewhat like the species under discussion in shape, and to a lesser extent in canal system and arrangement of the larger spicules. Lendenfeld regarded the difference in canal system great enough, however, to create a separate family for those of the type of *Polynia* and *Vosmaeria* (family Sylleibidae). *R. nuttingi* would be in this family if it were regarded as valid, but it is usually not so regarded. Furthermore, *nuttingi* differs so widely from *amphora* in other respects, especially in having the peculiar dermis with its special microscleres, that I believe the two can not fairly be classed as congeneric. I therefore hold with Urban, recognizing his genus, *Rhabdodermella.*

Order HEXACTINELLIDA Schmidt

Family HYALONEMATIDAE Gray

Genus HYALONEMA J. E. Gray

HYALONEMA POPULIFERUM Schulze

Hyalonema populiferum F. E. Schulze, 1899, p. 10.

Holotype.—U.S.N.M. No. 7557.

Type locality.—*Albatross* Station 2928, near San Clemente Island, Calif., depth 764 meters, sand bottom.

Other specimens recorded by Schulze from the vicinity of San Clemente Island are from:

Albatross Station 2936, depth 656 meters, mud bottom.
Albatross Station 2937, depth 847 meters, mud bottom.
Albatross Station 2980, depth 1,192 meters, mud bottom.

Family ROSSELLIDAE Schulze

Genus APHORME Schulze

APHORME HORRIDA Schulze

Aphorme horrida F. E. Schulze, 1899, p. 40.

Holotype.—U.S.N.M. No. 7504.

Type locality.—*Albatross* Station 2937, near San Clemente Island, Calif., depth 847 meters, mud bottom.

Genus ACANTHASCUS Schulze

ACANTHASCUS PLATEI Schulze

Acanthascus platei F. E. SCHULZE, 1899, p. 45.

Holotype.—U.S.N.M. No. 7502.

Type locality.—*Albatross* Station 2927, west from San Diego, Calif., depth 572 meters, mud bottom.

Genus STAUROCALYPTUS Ijima

STAUROCALYPTUS DOWLINGI (Lambe)

Rhabdocalyptus dowlingi LAMBE, 1893, p. 37.
Staurocalyptus dowlingi IJIMA, 1897, vol. 1, p. 53

Holotype.—In the Museum of the Geological Survey, Ottawa, Canada; described from the west coast of Canada.

Other records.—Schulze (1899, p. 47) described Californian specimens from *Albatross* Station 2955, depth 221 meters. This station is just south of Santa Rosa Island. The specimen he figures is U.S.N.M. No. 7578. He also had a specimen from Alaska.

STAUROCALYPTUS SOLIDUS Schulze

Staurocalyptus solidus F. E. SCHULZE, 1899, p. 51.

Holotype.—U.S.N.M. No. 7581.

Type locality.—*Albatross* Station 2948, near Santa Cruz Island, depth 486 meters.

Other specimens recorded by Schulze are from:

Albatross Station 3071, Washington, depth 1,253 meters.
Albatross Station 3202, Monterey Bay, depth 699 meters.

Three other specimens from Monterey Bay are in the collection of Stanford University. The species is also represented in the British Museum (No. 29.8.22.26).

Description (based on the Stanford University specimens).—Shape, vasiform; a hollow cylinder. Size, up to 15 cm in diameter, 24 cm high. Consistency, fragile. Color in life and when preserved, drab. Oscules, on cloacal surface only; round, 1 to 4 mm in diameter. Pores, on outer surface only; round, 0.2 to 0.4 mm in diameter. Surface covered with a forest of projecting spicules.

Parenchyma, about 23 mm thick. Prostalia marginalia, none as distinct from pleuralia. Prostalia pleuralia, abundant diacts 40 to 60 mm long. Prostalia basalia, none. Dermalia autodermal, diacts up to 20 mm long. Dermalia hypodermal, conspicuous pentacts, rhabds about 20 mm long, clads about 4 mm above the surface and each arm about 3 to 5 mm long. There are here also small pentacts, each arm spined and about 12μ by 150μ. Gastralia autodermal,

diacts 20 to 30 mm long. Gastralia hypodermal, abundant pentacts, each arm 200μ long. There are further a few diacts about 2 mm long, perpendicular to the surface and in, but not protruding from, the cloacal layer. Parenchymalia principalia, oxeas about 30 mm long. Parenchymalia comitalia, strongyles almost tylotes, with spined heads and four hemispherical protrusions so placed centrally as to indicate that this is a reduced hexact. Size, about 0.016 by 3 mm. Parenchymalia intermedia, oxyhexasters, all or most of the six primary rays being dichotomously branched. Each ray totals about 45μ long. There are also discohexasters of about 180μ total diameter.

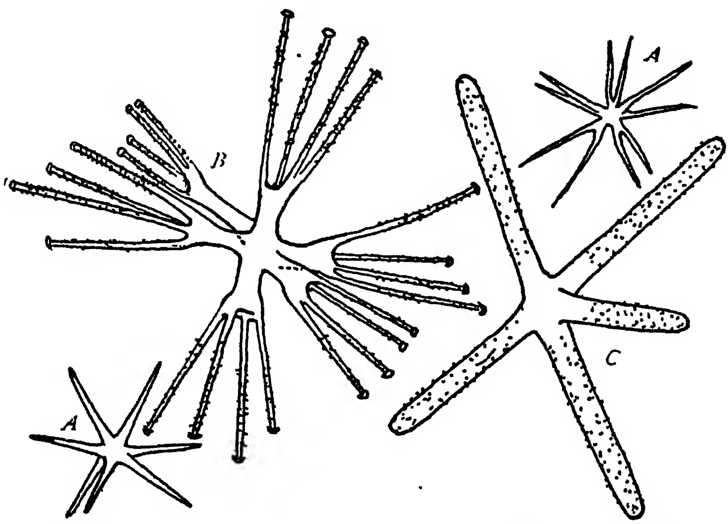

FIGURE 8.—*Staurocalyptus solidus* Schulze: *A*, Oxyhexasters; *B*, discohexaster; *C*, one of the smaller pentacts. ×300

Remarks.—Schulze's description is rather brief and is based in a large measure on a comparison to *Staurocalyptus dowlingi* (Lambe) Ijima. This latter form is described as having discohexasters 250μ to 320μ in diameter, as compared to *S. solidus*, which has discohexasters 150μ to 180μ in diameter; moreover, the former is semistipitate, but in other respects the two forms are practically identical. I follow Schulze in retaining these as separate species for the time being but with serious doubts. It is very possible that future work may show that *S. solidus* should fall as a synonym to *S. dowlingi*.

STAUROCALYPTUS FASCICULATUS Schulze

Staurocalyptus fasciculatus F. E. SCHULZE, 1899, p. 53.

Holotype.—U.S.N.M. No. 7580.

Type locality.—*Albatross* Station 2979, north of Santa Cruz Island, Calif., depth 690 meters, mud bottom.

Genus RHABDOCALYPTUS Schulze

RHABDOCALYPTUS DAWSONI (Lambe)

Bathydorus dawsoni LAMBE, 1892, p. 73.
Rhabdocalyptus dawsoni F. E. SCHULZE, 1899, p. 54.

Holotype.—In the Museum of the Geological Survey, Ottawa, Canada.

Type locality.—The west coast of Canada.

Other records.—Schulze (1899) has specimens from the same vicinity and from three California localities, as follows:

Albatross Station 2975, depth 66 meters, stony bottom.
Albatross Station 2945, depth 55 meters, stony bottom.
Albatross Station 3349, depth 437 meters, shell bottom.

The first two stations are near Santa Cruz Island, the last is just west of San Francisco. Schulze's figured specimen is U.S.N.M. No. 7570.

RHABDOCALYPTUS TENER Schulze

Rhabdocalyptus tener F. E. SCHULZE, 1899, p. 57.

Holotype.—U.S.N.M. No. 7577.

Type locality.—*Albatross* Station 2923, off San Diego, Calif., depth 1,503 meters, green mud bottom.

RHABDOCALYPTUS NODULOSUS Schulze

Rhabdocalyptus nodulosus F. E. SCHULZE, 1899, p. 58.

Holotype.—U.S.N.M. No. 7576.

Type locality.—*Albatross* Station 2980, off Santa Barbara, Calif., 1,103 meters, mud bottom. Schulze also had a second specimen from *Albatross* Station 2936, off San Diego, depth 657 meters, mud bottom.

RHABDOCALYPTUS ASPER Schulze

Rhabdocalyptus asper F. E. SCHULZE, 1899, p. 60.

Holotype.—U.S.N.M. No. 7568.

Type locality.—*Albatross* Station 2936, off San Diego, Calif., depth 657 meters, mud bottom.

Family EURETIDAE Zittel

Genus FARREA Bowerbank

FARREA CONVOLVULUS Schulze

Farrea convolvulus F. E. SCHULZE, 1899, p. 71.

Holotype.—U.S.N.M. No. 7553.

Type locality.—*Albatross* Station 2936, off San Diego, Calif., depth 656 meters, mud bottom.

Family COSCINOPORIDAE Zittel

Genus CHONELASMA Schulze

CHONELASMA CALYX Schulze

Chonelasma calyx F. E. SCHULZE, 1887, p. 326.

Holotype.—Location unknown.

Type locality.—Japan.

Other records.—The *Albatross* dredged this species from nine stations, as reported by F. E. Schulze (1899, p. 78), as follows:

Station 3326, Aleutian Islands, Alaska, depth 1,053 meters.
Stations 2877 and 2875, near Washington State, depths 108 and 73 meters.
Stations 2862 and 2864, near Vancouver, Canada, depths 435 and 88 meters.
Station 3051, near Oregon, depth 108 meters.
Station 3202, Monterey Bay, Calif., depth 699 meters, mud bottom.
Station 2952, near Santa Barbara, Calif., depth 104 meters, rocky bottom.
Station 2980, west of Santa Rosa Island, Calif., depth 1,103 meters, mud bottom.

The specimen that Schulze figures is U.S.N.M. No. 8585.

CHONELASMA TENERUM Schulze

Chonelasma tenerum F. E. SCHULZE, 1899, p. 81.

Cotypes.—U.S.N.M. Nos. 7540 and 7541.

Type locality.—*Albatross* Station 2916, depth 170 meters, stony bottom (1 specimen), and *Albatross* Station 2919, depth 1,800 meters, mud bottom (5 specimens). Both stations are in the vicinity of the Cortez Bank, Calif., which, strictly speaking, lies in Mexican waters. Four paratypes (U.S.N.M. No. 7542) were taken at *Albatross* Station 2923, depth 1,503 meters, mud bottom, off San Diego, Calif.

Family APHROCALLISTIDAE Schulze

Genus APHROCALLISTES J. E. Gray

APHROCALLISTES VASTUS Schulze

Aphrocallistes vastus F. E. SCHULZE, 1887, p. 317.
Aphrocallistes whiteavesianus LAMBE, 1892, p. 74.

Holotype.—Location unknown.

Type locality.—Japan.

Other records.—Lambe's specimen was from Canadian waters. According to Schulze, the *Albatross* dredged this from 13 stations, as follows:

Stations 3316, 3330, 3331, and 3337, in Alaskan waters, depths 565, 642, 640, and 512 meters, respectively.
Stations 2860, 2862, 2864, and 2877, off the coast of Canada, depths 1,602, 435, 88, and 108 meters, respectively.
Stations 2882 and 3054, off the coast of Oregon, depths 124 and 97 meters, respectively.
Station 3008, off the coast of Mexico, depth 560 meters.

Station 2925, near San Diego, Calif., latitude 32° 32′ N., longitude 117° 24′ W., depth 620 meters, mud bottom.

Station 2935, near San Diego, Calif., latitude 33° 04′ N., longitude 117° 42′ W., depth 839 meters, mud bottom.

In the dredging operations of E. F. Ricketts, of the Pacific Biological Laboratories, Pacific Grove, Calif., there have been brought up and presented to me by him, macerated skeletons evidently belonging to the genus *Aphrocallistes* and very probably to the species *vastus;* but they lack the soft parts and loose spicules.

Order MYXOSPONGIDA Sollas

Family HALISARCIDAE Schmidt

Genus HALISARCA Johnston

HALISARCA SACRA de Laubenfels

Halisarca sacra DE LAUBENFELS, 1930, p. 25.

Holotype.—U.S.N.M. No. 21454; B.M. No. 29.8.22.53.

Type locality.—Elkhorn Slough, at the east side of Monterey Bay, Calif. Collected by E. F. Ricketts, July 4, 1929. I also have collected the species at the same locality. It is found associated with *Mycale macginitiei* on rocks introduced by man in the midst of an environment of sheltered tidal mud flats.

Description.—Shape, encrusting. Size, up to 0.7 mm thick, in patches up to 14 mm in diameter. Consistency, very soft. Color in life and when preserved, very pale drab. Oscules, about 100μ to 200μ in diameter. Pores, very minute, well under 50μ; exact sizes obscured by contractility, but none observed more than 10μ. Surface, superficially shiny smooth.

Ectosomal specialization, 20μ to 40μ thick, characterized by rounded cells in a more darkly staining ground mass than that of the endosome. There are subdermal cavities about 20μ in diameter. Endosomal structure, collenchymatous. The abundant mesogloea takes nuclear stains very definitely. Histological details: The exceedingly long flagellate chambers are often radiately clustered around excurrent canals, which are often near the substrate. Many prosopyles are very short, and often there is almost direct contact with the subdermal cavities. The chambers are always about 40μ in diameter, and average well over 200μ long, lengths up to 280μ being common.

Remarks.—Some authors regard all Halisarcas as conspecific with *H. dujardini*, the genotype. The genus is so simplified that it is very difficult to find adequate grounds for separating any species from *dujardini*, but I hesitate to believe that all the members found over the entire world really are conspecific. This, our California

representative, is, of course, close to the genotype, but may be separated, I believe, on the basis of the extreme length of the flagellate chambers. In the literature one finds few or no references to chambers longer than 125μ, though I have seen in the British Museum prepared slides showing chambers—presumably of the genotype—longer than 200μ; these are, however, out of the ordinary for European or Australian material. In *sacra* they are usually well

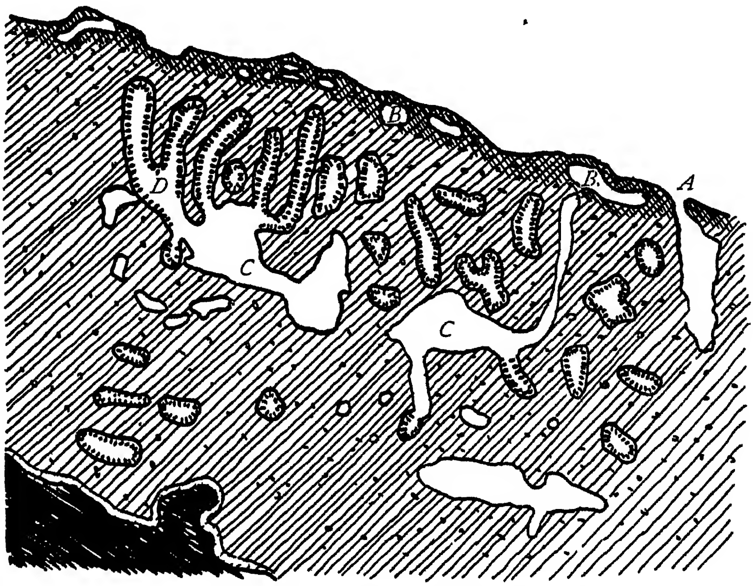

FIGURE 9.—*Halisarca sacra* de Laubenfels: Typical section perpendicular to the surface. It was found impractical to draw in fine items of detail. *A*, An oscule; *B*, subdermal cavities; *C*, excurrent canals, *D*, flagellate chamber, ×120

over 200μ and rather often reach lengths of 280μ. The general picture as made by slides of *sacra* is so different from that made by other slides of this genus that I have seen that I had a certain degree of confidence in naming this as a new species.

Order CHORISTIDA Sollas

Family GEODIIDAE Gray

Genus SIDONOPS Sollas

SIDONOPS ANGULATA Lendenfeld

Sidonops angulata LENDENFELD, 1910, p. 18 (based on three described varieties: *megana*, *microana*, and *orthotriaena*).
Sidonops bicolor LENDENFELD 1910, p. 46.

Holotype.—Here established as U.S.N.M. No. 8380, *S. angulata* var. *microana.*

Type locality.—*Albatross* Station 4417, 53 meters, off Santa Barbara Island, Calif.

Occurrence.—Lendenfeld identifies as *S. angulata* 4 specimens dredged by the *Albatross* near Santa Barbara Island, southern California, Stations 2945, 2975, and 4417, and as *bicolor* 15 specimens in the same collection dredged at Stations 2958, 2981, 3168, 4420, 4531, and 4551. These range from southern to central California. The depths are from 42 to 100 meters.

Description.—Tuberous, usually with digitate processes. Largest specimen 4 by 10 cm. In spirits, externally whitish to rufous to brown, internally dirty yellowish. A spicule fur covers much of the surface. The smooth areas are probably always, and sometimes certainly, due to such external causes as, for example, overlying bryozoans. The round oscules are usually in groups, often on raised processes, and vary from 0.25 to 1 mm in diameter. The pores are in chones. The cortex is from 1 to 2 mm thick and, as is the rule in this family, is packed with sterrasters. Spicules: (*a*) Special dermal diacts up to 0.04 by 9 mm; (*b*) endosomal diacts up to 0.105 by 5.6 mm; (*c*) plagiotriaenes, the cladomes often reduced to diaenes or monaenes, rhabds up to 0.11 by 4 mm; (*d*) anatriaenes, often absent, when present with rhabds up to 0.039 by 9 mm; (*e*) sterrasters from 0.087 by 0.122 mm to 0.097 by 0.17 mm; (*f*) spherasters with spined tornote rays, total diameter often around 0.021 to 0.028 mm; (*g*) euaster rays sharply oxeote and sometimes microspined, sometimes smooth, total diameters up to 0.064 mm.

Remarks.—I have not examined Lendenfeld's specimens personally, so use his published data, with this warning: E. F. Hallmann, 1914, examined the material from which Lendenfeld described very numerous Australian sponges and reports serious inaccuracies in many of Lendenfeld's descriptions. Although Lendenfeld produced two large volumes on the Geodidae of the *Albatross* dredgings, I feel we can only surmise the true status of his species pending a re-examination of the material by some competent investigator.

In establishing *angulata* and *bicolor* Lendenfeld (1910) mentions for the former that some of the spicules were sharply bent. This is a very common malformation in many sorts of sponges. In the same article Lendenfeld figures such deformities for various of the Geodias. He does not say this feature was conspicuously absent from his *bicolor*. He established this latter name because of darker color on one side than the other. As is well known, sponges receiving more light from one side than the other tend to be darker on the exposed side. Lendenfeld notes (p. 47) that the darker was the upper side of these specimens. *S. bicolor* and *S. angulata* are not to be separated on such differences alone.

Genus GEODIA Lamarck

GEODIA MESOTRIAENA Lendenfeld

Cydonium mülleri LAMBE (not Fleming), 1892, p. 72; 1893, p. 36.
Geodia mesotriaena LENDENFELD, 1910, p. 96.
Geodia agassizii LENDENFELD, 1910, p. 113.
Geodia mesotriaenella LENDENFELD, 1910, p. 151.
Geodia breviana LENDENFELD, 1910, p. 155.
Geodia ovis LENDENFELD, 1910, p. 161.

Holotype.—Here designated as U.S.N.M. No. 8410.

Type locality.—*Albatross* Station 2942, off southern California, 41 meters.

Occurrence.—Lendenfeld had 10 specimens from California, from *Albatross* Stations 2894, 1909, 2942, 2958, 2975, 2978, 4417, 4551, and 3168; and 24 specimens from north of California, Stations 2886, 2887, 3098, 4193, 4199, and 4228, ranging from Oregon to southeastern Alaska. I have four specimens from southern California, all dredged by the University of Southern California at depths from 41 to 47 meters. The *Albatross* specimens were from 32 to 180 meters, except one from 369 meters. This species is also represented in the British Museum (No. 29.9.30.11).

Description.—Shape, massive; younger specimens subglobular, older ones spread laterally to form cakes. Size, up to at least 6 cm thick, spreading laterally to at least 20 cm. Consistency, mediocre. Color in life and when preserved, whitish externally, dirty yellow internally, the exterior often discolored on account of outside influences. Oscules, chones. Pores, chones. Surface, superficially covered by a dense spicular plush, which may be broken off, but in that case it is represented by broken ends of spicules.

Ectosomal specialization, cortical; it is largely sterraster armor and ranges from 200μ to 1 mm thick. Endosomal structure, radiate, Histological details: I have a slide showing spherical flagellate chambers that are 16μ to 20μ in diameter.

Spicules: (*a*) Large endosomal diacts, rarely styles or strongyles, usually oxeas (fig. 10, *H*); size, 20μ to 112μ thick. Lengths are hard to state as the longer ones are usually broken, but they reach at least 9 mm. The common size is about 0.05 by 2.5 mm. (*b*) Plagiotriaenes or diaenes (fig. 10, *J*, *K*) of the same size range as the oxeas mentioned above. These are placed with their cladomes just below or actually within the cortex, the rhabds continuing on down, directed toward the base or center of the sponge. (*c*) Anatriaenes of very great variation in size and abundance (fig. 10, *D*, *E*, *F*, *G*). In the same specimen their rhabd diameter may range from 2μ to 45μ. They are commonly 5 to 10 mm in length, in extreme cases as much as 22 mm long. They may be placed like the plagiotriaenes, or their

cladomes may be actually projecting beyond the surface of the sponge. (*d*) A type of spicule (fig. 10, *A*, *B*, *C*) that is typically a mesoprotriaene but may have a very small epirhabd or none; may be protriaene or orthotriaene; or may be triaene, diaene, or monotriaene. This occurs usually or always in the spicule fur, and therefore tends to be lost when that is rubbed off. Its frequency and shape seem to be the most characteristic items distinguishing California Geodias. I find rhabd diameter 11μ to 48μ. Lendenfeld reports 7μ to 12μ. (*e*) Dermal small oxea or styles (fig. 10, *L*), diameters 2μ to 13μ, lengths

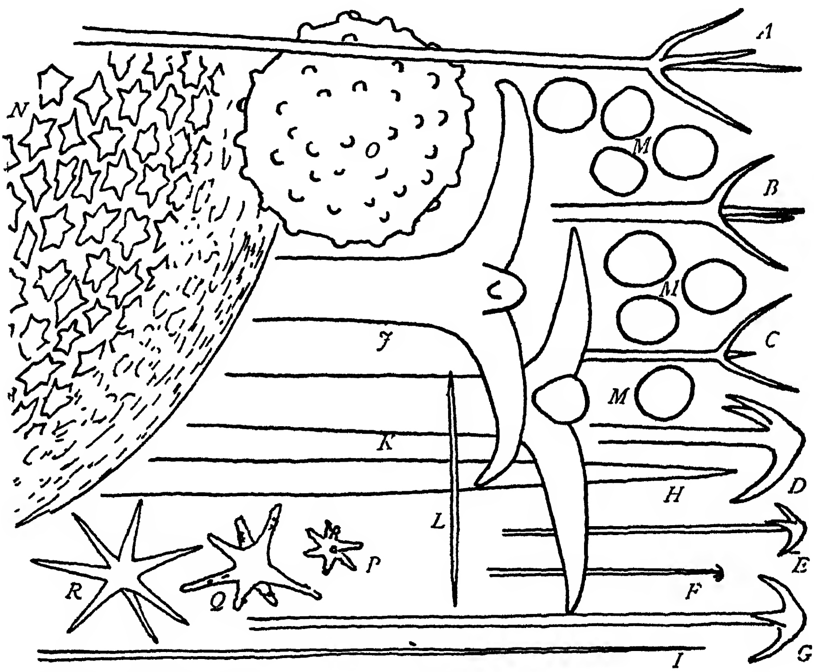

FIGURE 10.—*Geodia mesotriaena* Lendenfeld: Spicules *A* to *M*, $\times$80; others, $\times$1,333. *O*, a developmental form of the sterraster, of which *N*—to the same scale—can only show a small bit of the surface. *H*, pointed end, which is the same for the oxeas and the esactines of the plagio spicules. *I*, esactine of the other polyactinal megascleres

usually about 200μ. (*f*) Sterrasters (fig. 10, *M*, *N*, *O*), greatest lengths ranging from 65μ to 118μ, least diameters from 42μ to 83μ, usually 50μ by 70μ by 60μ. (*g*) Strongylospherasters (fig. 10, *P*, *Q*), 4μ to 15μ in diameter. (*h*) Oxyspherasters 6μ to 24μ in diameter. (*i*) Oxyeuasters 9μ to 35μ in diameter (fig. 10, *R*). It might be much more accurate to say there are small asters of great variability, the ends of the spines varying from strongylote (rounded) to oxeote (sharp) but usually more rounded in the smaller and sharper in the larger. A centrum may be present varying from comparatively very large to absent, but most conspicuous in the smaller asters. The rays seem always to be spined, but the spines vary from almost invisible to very

conspicuous. The whole range can be found within a single specimen, though not in every specimen.

Remarks.—In his work on the Geodidae, Lendenfeld (1910) described as new 11 species from the west coast of North America. The 10 specimens from California he placed in 5 new species. According to these standards, I would have needed two new species for my four specimens, continuing the average of a new species for each two specimens. This probably does not represent the true state of affairs. It is possible that we have here but one *Geodia*, exhibiting a considerable range of variability. Table 1 (p. 28) gives the spicule measurements of my four specimens and Lendenfeld's five species, based on his figures. Since each spicule goes through all intermediate sizes before attaining its maximum and since it may require a very long time in accomplishing this growth, many specimens might lack maximum sizes. I believe this table gives good grounds for merging all these into one species. Are there any grounds for splitting them into more than one?

In discussing *mesotriaena*, Lendenfeld emphasized the mesotriaenes. They are specified in his other four species. It seems that the frequence and development of this type of spicule do distinguish the California Geodias from those of, say, Asia or Europe. It is practically the only difference from some East Indian Geodias, but can not be used to separate our local forms into species.

Lendenfeld does not set forth differences between *mesotriaena* and *agassizii*, though his tables show the latter to have somewhat smaller mesotriaenes. The mesotriaenes typically protrude from the surface and may be broken off by animals crawling over the sponge, or by jostling in the dredge as it comes up. Furthermore, the longest ones are the most likely to be lost. The differences Lendenfeld shows are probably due to the fact that some specimens receive somewhat rougher treatment in collecting than the others.

G. mesotriaenella is based upon one specimen that had none of the larger sizes of spicules. In view of the probability that this is but a younger specimen (it was only 1.5 by 2 cm), no species should be made for it.

G. breviana is established for a specimen that Lendenfeld says had anatriaenes with much shorter clads than the other specimens. His illustration shows no conspicuous difference in this respect, and the agreement of other characteristics leads one to believe this was but a very slightly aberrant individual.

For *ovis* Lendenfeld emphasizes its very thick spicule fur and mentions its very small as well as very large anatriaenes. These smaller ones may be merely a new crop beginning to form. Practically all its other spicules, including many of the anatriaenes, are somewhat larger than in the others, and it has expanded laterally

farther than any. It seems likely that this is but a more mature specimen than any of the others. There is one most interesting item in its description, however. Lendenfeld states the spicule fur was about 20 mm high. The very longest spicule he records is 23 mm long. Not only do his tabulated measurements show that most of the spicules involved were less than 20 mm, but he specifically says (p. 163) that there are spicules lying in it freely. It is hardly conceivable that the nonattached spicules came from another sponge. We have here, then, proof of the shedding of spicules, and the great thickness of the fur in this specimen is due, in all probability, to good fortune in not having had the loose extra layers washed or shaken off.

Lambe in 1892 (p. 72) records a sponge from Vancouver Island as *Cydonium mülleri* Fleming. Lendenfeld says it is his *breviana*. Lambe in 1893 (p. 36) records another from Queen Charlotte Islands, about 3° of latitude away, also as *Cydonium mülleri*. Lendenfeld says it is his *agassizii*. Lendenfeld is probably correct in separating Lambe's from Fleming's species, but Lambe was probably quite right as to the identity of the two with each other. In fact, Lendenfeld quotes the 1893 article in both respects and, but for a clew given by his page references, gives every indication that he is talking about the same sponge in both cases. (See Lendenfeld, 1910, pp. 113, 155.)

TABLE 1.—*Measurements of the spicules of California Geodias*

Spicule [1]	mesotriaena	agassizii	mesotriaenella	breviana	ovis	Specimen A	Specimen B	Specimen C	Specimen D
	μ	μ	μ	μ	μ	μ	μ	μ	μ
Endosomal diacts	50–105	60–112	20–50	30–88	30–40	27–148	26–65	55–59	27–67
Rhabds of plagiotriaenes	85–120	65–150	75–120	60–130	74–100	27–90	52–70	65–85	40–104
Rhabds of anatriaenes	8–40	10–50	18–30	25–40	2–45	13–16	17–30	16–30	13–25
Rhabds of mesotriaenes	38–70	7–40	9–19	15–32	20–120	25–33	11–27	13–48	14–30
Dermal diacts	9–19	5–12	4–5	2–9	8–13	7–13	4–12	3–12	7–9
Length of sterraster	92–125	82–118	87–107	84–105	82–92	72–87	70–73	65–85	65–95
Sterraster	67–82	58–89	58–68	55–77	54–61	48–78	42–57	45–52	55–76
Strongylospheraster	6–14	4–11	6–11	6–12	?	8–15	9–14	14–15	6–9
Oxyspheraster	19–32	10–21	20–21	12–21	11–24	6–15	12–15	12–21	6–20
Oxyeuaster	19–54	9–31	17–26	16–27	20–35	20–28	?	28–30	20–30

[1] Diameters, except where stated as "length."

Genus GEODINELLA Lendenfeld

GEODINELLA ROBUSTA Lendenfeld

Geodinella robusta var. *megasterra* LENDENFELD, 1910, p. 205.

Holotype.—U.S.N.M. No. 8389.

Type locality.—*Albatross* Station 2946, off southern California, 270 weters.

Other records.—Lendenfeld describes as varieties of this species other specimens from Vancouver Island to southeastern Alaska.

Description (after Lendenfeld).—Massive, 10 by 16 by 43 mm, dirty white. The surface was covered by a monaxonid sponge, but it shows indications of a spicule plush broken off. The efferent and afferent openings are chones. The cortex, largely sterraster armor, is about 1 mm thick. Spicules: (*a*) Endosomal oxeas up to 0.04 to 0.08 by 2.5 mm; (*b*) plagiomonaenes, rhabds 0.026 to 0.042 by 2.1 mm; (*c*) sterrasters, 0.88 by 0.18 to 0.13 by 0.237 mm; (*d*) strongylospherasters 0.007 to 0.013 mm; (*e*) oxyspherasters to oxy(eu)-asters, 0.009 to 0.038 mm.

Remarks.—This form differs from the common California Geodias by lacking the mesotriaenes, which might well be due to accident in collection or misadventure to the growing sponge. It is significant that the specimen had been overgrown by another sponge. It also lacks anatriaenes. My observation is that their occurrence is very patchy; I found them in all my local specimens of *Geodia*, but while in one they were abundant, in another it required careful search to locate any. Its plagioclad spicules are never triaene, according to Lendenfeld, but usually monaene or at most diaene. These modifications are common in Geodias along with regular triaenes. Its sterrasters are, according to Lendenfeld's statistics, definitely of a larger size range than for *Geodia mesotriaena*. This, with the other more dubious differences, leads me to treat this provisionally as a separate species.

Family STELLETTIDAE Sollas

Genus STELLETTA O. Schmidt

STELLETTA CLARELLA de Laubenfels

Stelletta clarella DE LAUBENFELS, 1930, p. 25.

Holotype—U.S.N.M. No. 21488; B. M. No. 29.8.22.27.

Type locality.—Pescadero Point, near Carmel, Calif., intertidal, July, 1925, my collecting. Many specimens were examined, as the species is abundant in the Monterey Bay Region. It is frequently found under overhanging ledges near low-tide mark and seems always confined to well-shaded locations.

Description.—Shape, massive to encrusting. Size, up to 7 cm; thick, spreading laterally indefinitely; I have seen encrustations of this species over 40 cm in diameter. Consistency, spongy to cartilaginous. Color in life and when preserved, white; usually more or less dirty. Thin sections cut tangent to the surface show it to be packed with the cladomes of the dichotriaenes with the areas between uniformly closed over by flesh. The pores are abundant, 50μ to

100μ in diameter when open, and about 200μ from center to center over almost the entire surface. The oscules are chones, diameter about 500μ to 600μ, with the sieve openings 100μ to 150μ. Surface superficially very hispid. There is a dense spicule fur 3 mm high, composed of erect spicules. As is often true of tetraxon sponges, this spicule plush renders the sponge more dangerous to touch than a cactus plant; numerous spicules penetrate the skin and are removed only with much pain and difficulty.

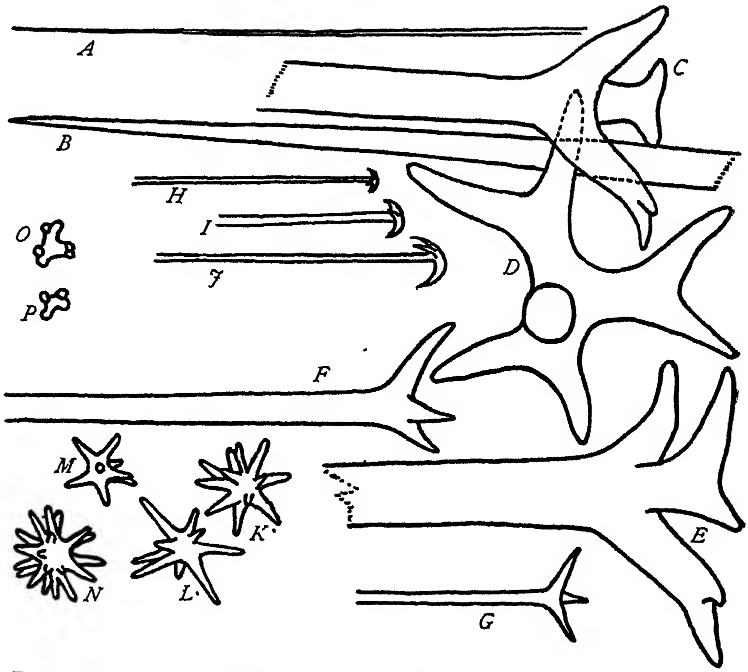

FIGURE 11.—*Stelletta clarella* de Laubenfels: *A* to *G*, ×80; others, ×1,333. *A*, either end of the ectosomal oxea, or the esactinal termination of the anatriaene; *B*, either end of the endosomal oxea, or the esactinal termination of the plagio spicule; *C–G*, variations of the principal radiate spicule. Any of this spicule sort may be diaene instead of triaene in this species. The range from orthotriaenes through plagiotriaenes to dichotriaenes is a matter of age; *H–J*, anatriaenes; *K–N*, euasters; *O*, *P*, siliceous structures

Ectosomal specialization, corticate, cartilaginous, about 1 to 2 mm thick. Endosomal structure, the smaller masses are strongly radiate in structure and even in the larger encrustations the structures within about 1 cm of the surface are strongly marked by fascicular columns of spicules perpendicular to the surface.

Principal spicules, oxeas (fig. 11, *B*); size about 50μ by $3{,}500\mu$. Ectosomal spicules, oxeas (fig. 11, *A*); size about 15μ by $1{,}400\mu$. Interstitial spicules, anatriaenes (fig. 11, *H*, *I*, *J*); size of rhabds 9μ by $1{,}100\mu$ to 15μ by $2{,}000\mu$, chords 45μ to 90μ. Chief radiate spicules

orthotriaenes to plagiotriaenes to dichotriaenes (fig. 11, *C*); size of rhabds, 20μ by 2,000μ to 100μ by 3,000μ, chords 120μ to 180μ. (See below for further details.) Microscleres, euasters (fig. 11, *K*, *L*, *M*, *N*); diameter, 9μ to 15μ. Their rays vary from oxeote to strongylote, and from spiny to smooth; they are located throughout the sponge.

I find also small siliceous structures (fig. 11, *O*, *P*) in some parts of some specimens; these may be malformed microscleres, a second sort of microsclere, or (more probably) foreign inclusions.

Remarks.—The nearest relative of this form seems to be *S. lendenfeldi* Sollas, 1888, from Australia, which differs in having tylasters; these two and *S. estrella* are unique in the small size of the aquiferous apertures.

Related species of this genus are reported from all parts of the world.

STELLETTA ESTRELLA de Laubenfels

Stelletta estrella DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21399; B.M. No. 29.9.30.10.

Type locality.—Southern California, collected by the University of Southern California, July 10, 1926. Exact locality not known.

Additional material examined.—I collected two specimens at Laguna Beach, intertidal. Two others were dredged by the University of Southern California—one September 26, 1925, near Long Beach, depth 28 meters, the other October 10, 1925, near San Pedro, depth 41 meters.

Description.—Shape, subspherical to massive. Size, up to 5 cm thick and at least 7 cm in diameter. Consistency, spongy to cartilaginous. Color in life and when preserved, white, often dirty. Oscules, inconspicuous, diameter about 1 mm; they are merely scattered, simple holes. Pores, at least 130μ diameter, abundant, scattered. Surface, superficially very hirsute, often much covered by foreign material.

Ectosomal specialization, cortical, about 1 mm thick; it is cartilaginous, hyaline, dense, and contains a few asters and is traversed by megascleres. There is a spicule fur, 1 to 3 mm high, of erect spicules, mostly plagiotriaenes with their cladomes far out from the sponge surface. Endosomal structure, fundamentally radiate in plan, though this is obscured in the central portions of older specimens.

Principal spicules, oxeas (fig. 12, *F*, *G*, *H*); size 45μ by 2,600μ to 100μ by 4,000μ. Ectosomal spicules, plagiomonaenes, diaenes, or triaenes (fig. 12, *A*, *B*, *C*, *D*, *E*); size of rhabds 9μ to 78μ by 4,000μ, chords 35μ to 200μ. The latter two sorts now and then have the dicho-modification; some of the larger ones are plagiomesotriaenes.

First microscleres, oxyspheraster (fig. 12, *K*, *L*, *M*); diameter 2½μ to 12μ. Second microsclere, tylospheraster (fig. 12, *I*, *J*); diameter, 10μ to 11μ. These are rather uncommon.

Remarks.—This species is peculiar for the very large average size of its megascleres; not many other Stellettas have quite such enormous ones. *S. clarella* from central California has a few as large and, like *S. estrella*, has very inconspicuous vents, but the two are separated in many ways. The northern form has chiefly strongylote rayed asters; the southern form has few or none of that sort, but

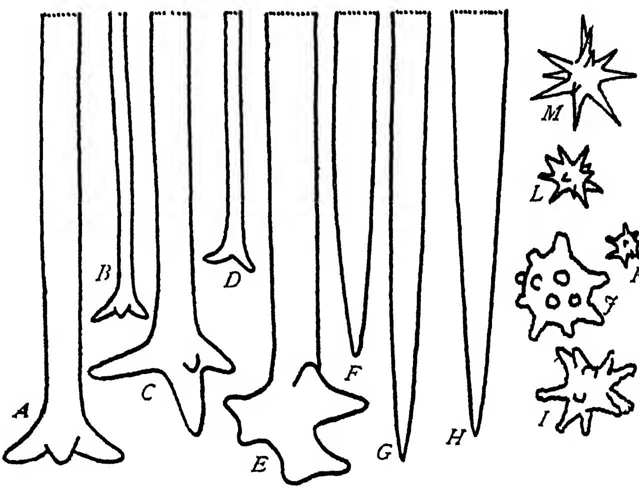

FIGURE 12.—*Stelletta estrella* de Laubenfels: Spicules *A* to *H*, ×80; others, ×1,333 *A–E*, endosomal spicules; *F*, *G*, and *H*, variation in ends of the axeas and esactinal ends of the tetractinal megascleres; *I*, *J*, tylospherasters; *K–M*, oxyspherasters

instead has two distinct sorts, one with decidedly oxeote and the other with tylote rays. Two other features separate *estrella* not only from *clarella* but indeed from most other Stellettas; first, the peculiarly short clads typical of this species, and second, the lack of anatriaenes. That the clads of the plagiotriaenes project beyond the surface is also noteworthy.

Family THENEIDAE Sollas

Genus POECILLASTRA Sollas

POECILLASTRA RICKETTSI[1] de Laubenfels

Poecillastra rickettsi DE LAUBENFELS, 1930, p 26.

Holotype.—U.S.N.M. No. 21482; B.M. No. 29.8.22.7.

Type locality.—Monterey Bay, Calif., 800 meters; collected by E. F. Ricketts, July, 1925. Notes on other specimens that he col-

[1] Named for E F. Ricketts, of the Pacific Biological Laboratories, Pacific Grove, Calif

lected from the same general locality and depth, in May, 1929, are given under Remarks below.

Description.—Shape, various (see discussion below). Size, up to 2 cm thick, 20 cm in diameter. Consistency, fragile, friable. Color in life and when preserved, pale drab. Oscules, skeletal openings, 1 to 2 mm in diameter, and about 2 to 10 to the square centimeter. They are covered with a fenestrated membrane packed with asters, having roundish apertures about 0.4 mm in diameter. They open from subdermal spaces upwards of 1.2 mm in depth into which open numerous afferent pores usually 0.2 to 0.7 mm in diameter. Pores, skeletal openings, about 1 mm in diameter, covered with a fenestrated membrane having apertures 0.1 to 0.2 mm in diameter. The skeletal pores and oscules are roughly outlined (surrounded) by the cladomes of the ectosomal tetraxons. Surface, superficially smooth, with scattered projecting spicules a few millimeters high.

Ectosomal specialization: A dermal membrane about 40μ thick, very fragile and delicate; it contains abundant asters. Endosomal structure "crumb-of-bread," with fascicular tracts of oxeas, others scattered, and abundant scattered calthrops. Many calthrops have three of their rays directly beneath the dermis and parallel to it. Principal tracts (found only running lengthwise of lamellate forms), 100μ to 200μ in diameter.

Principal spicules, calthrops (fig. 13, *A*, *B*, *C*); size of rays, 50μ by 450μ to 70μ by 650μ. Interstitial spicules, oxeas, sometimes styles (fig. 13, *D*, *E*, *F*); size, about 65μ by 3,700μ. Coronal spicules, oxeas (not figured); size, 15μ to 30μ by 17,000μ. First microscleres, abundant plesiasters (fig. 13, *J*, *K*); size of rays, about 6μ to 8μ long, greatest diameter 14μ to 18μ. Some have so few rays that they are microcalthrops. Second microscleres, rare spirasters or metasters (fig. 13, *L*, *M*, *N*); length, 10μ to 13μ; rays about 3μ long. Third microscleres, toxas (fig. 13, *I*); length, about 80μ; located throughout the sponge. These toxas are, of course, quite probably foreign, yet they are found in every part of the holotype that I have examined. One can hardly believe them proper, yet their occurrence deserves mention. Fourth microscleres, microxeas, 4μ by 170μ to 5μ by 270μ (fig. 13, *G*, *H*). As many Poecillastras have spined microxea, I made an especial examination of these. With very high magnification (more than 1,000 diameters), the surface of these spicules was seen to very minutely roughened. As such roughening might be detected on almost any spicule by sufficient magnification, it is questionable how much taxonomic value it has. These spicules are rather evenly distributed throughout the sponge.

Remarks.—The holotype is of the usual form of *Poecillastra*, with spiculation not greatly differing from *P. compressa*, *P. schultzei*, and

P. laminaris. This shape is found, however, mainly in the largest fragments, some 10 cm in diameter, which seem to have been part of a large platelike growth about 20 cm high; its oscular surface covers most of the concave side. On the small fragments such oscular fields as the following are observed: Oval, 1 by 2 cm and depressed 1 cm; hourglass shaped, each oval 1 by 2.5 cm and depressed 1 cm; oval, 1 by 3.5 cm and depressed 1 cm; triangular, 1 by 1.5 cm and depressed only about 3 mm. It must be stressed that each oscular area was surrounded by a dense coronal palisade of very long spicules, usually very close to 17 mm in length except in the smaller specimens. The function of these seems to be separation of exhalent current from inhalent.

On May 1, 1929, Mr. Ricketts brought up a macerated hexactinellid dictyonine skeleton from very much the same depth and locality as of the type. On it were about a dozen sponges that I iden-

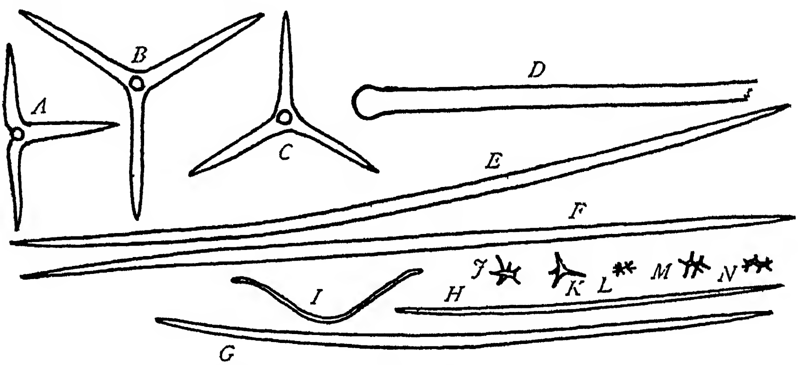

FIGURE 13.—*Poecillastra rickettsi* de Laubenfels: *A* to *F*, ×14; others ×300

tify as conspecific here. These are rough cylinders, the largest about 1.5 cm high and 2 cm in diameter, the smallest 1 cm high and 3 mm in diameter. The spiculation is the same, except that I do not find the toxas in them. The oscular areas with covering fenestrated membrane, the convex pore surfaces, and the dense coronal palisades are all the same. The inference is that this species grows to a height of about 1 cm before expanding laterally very much, but that afterwards its growth is almost exclusively horizontal.

Do all Poecillastras have such a change of form during their life history? It is to be noted that many of the specimens might fairly be classed as *Sphinctrella*, except that they lack the annulation so characteristic of the spicules of those certainly *Sphinctrella*.

Were the toxas proper, they would be a most striking feature. As it is, the enormous oscular crowns distinguish this species from all others of the genus. *P. laminaris* Sollas (1886, p. 186) from the East Indies is probably the closest, as it had a low (4.5 mm) fringe around its oscular areas.

POECILLASTRA TENUILAMINARIS (Sollas)

Normania tenuilaminaris SOLLAS, 1886, p. 186.
Poecillastra tenuilaminaris SOLLAS, 1888, p. 85.

Holotype.—B.M. No. 89.1.1.31.

Type locality.—Japan.

Material examined.—The specimen described below (U.S.N.M. No. 21400; B.M. No. 29.9.30.9) was trawled by the University of Southern California, June 23, 1916, west of Santa Catalina Island, Calif., depth not given.

Description.—Shape, lamellate. Size, 9 to 13 mm thick and about 10 cm high. Consistency, stiffly fragile. Color in alcohol, drab. Oscules, scattered, on one face only; diameter about 0.9 mm; distance apart, less than 1 cm. Pores, small and scattered, principally or only on the nonoscular face. Surface, superficially smooth.

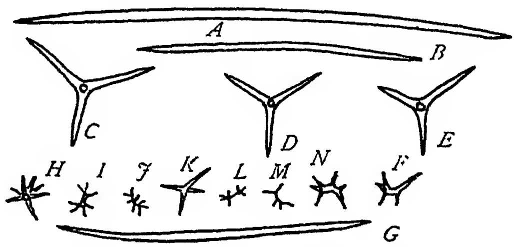

FIGURE 14.—*Poecillastra tenuilaminaris* (Sollas): *A–E*, megascleres, ×14; lower spicules are the microscleres, ×300. A row of typical asters is shown to illustrate the range of variation from plesiasters almost to spirasters

Ectosomal specialization, not evident. Endosomal structure, a confused mass of calthrops and oxeas.

Principal spicules, calthrops (fig. 14, *C*, *D*, *E*); size of rays, about 40μ by 350μ. Interstitial spicules, exeas (fig. 14, *A*, *B*); size 35μ by 1,350μ to 45μ by 2,500μ. First microscleres, plesiasters (fig. 14, *F*); length, 20μ to 28μ. Second microscleres, metasters (fig. 14, *L*); length, 14μ to 16μ. Third microscleres, microxeas (fig. 14, *G*); size, about 3μ by 135μ.

Remarks.—This genus is regarded by various authors, for instance, Dendy, as synonymous with *Pachastrella*, but I hold with Wilson (1925) in retaining *Poecillastra*. Many of the species referred to the latter are probably conspecific with *tenuilaminaris*, but, pending a revision of the genus, I make no decisions in this regard but would comment that following such revision it may devolve that some other specific name has priority.

Genus PENARES J. E. Gray

PENARES CORTIUS de Laubenfels

Penares cortius DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21479; B.M. No. 29.8.22.47.

Type locality.—Collected by me at Pescadero Point near Carmel, Calif., intertidal, July, 1925.

Additional material examined.—On April 15, 1929, E. F. Ricketts dredged this species in shallow water in Monterey Bay. I collected a third specimen on Monterey Peninsula, intertidal, in the summer of 1930; all three are very similar to one another.

Description.—Shape, massive. Size, 4 cm thick, 10 cm in diameter. Consistency, mediocre; the ectosome is tough and leathery. Color in life and when preserved, drab, except that in life the ectosome in places is very dark brown, paling after death. Oscules, oval, size about 1 by 2.5 mm; there is one for about every 5 square centimeters.

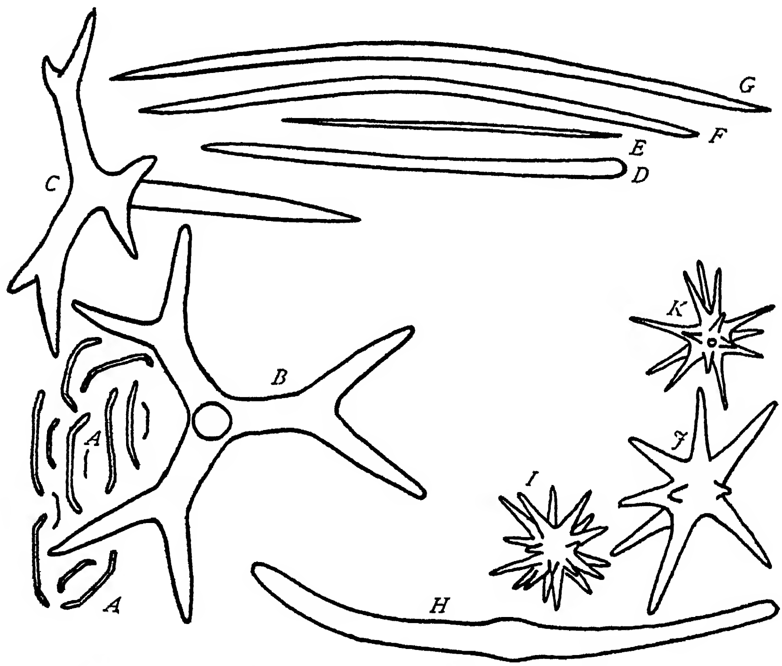

FIGURE 15.—*Penares cortius* de Laubenfels: *A–G*, ×80; others, ×1,333. *A–A*, range in size of the peculiar microsclere, to the same scale as the megascleres; *H*, unusual shape of the same spicules, with the centrotylote modification; *B, C*, dichotriaenes; *D, E*, unusual shape and size for the principal spicules; *F, G*, oxeas; *I–K*, oxyspherasters

They are often on low prominences about 3 mm high and 10 mm in diameter. Pores, at least 65μ in diameter; spaced about 250μ from center to center. Surface, superficially smooth to minutely punctiform.

Ectosomal structure, a densely felted mass of the bicurvates, containing also the cladomes of the dichotriaenes; thickness about 200μ. This is very easily detachable. Endosomal structure "crumb-of-bread," with evident spicules (diactines) mostly in confusion, but with traces of tracts. Principal, or ascending, tracts, 170μ tc 230μ in diameter, fascicular, few and scattered.

Principle spicules, oxeas (fig. 15, *F*, *G*) ; size, ranging up to 22μ by 950μ. Ectosomal spicules, dichotriaenes (fig. 15, *B*, *C*) ; size of rhabds, about 50μ by 400μ; size of clads, including the deuteroclads, up to 50μ by 310μ. First microscleres, bicurvate microstrongyles (fig. 15, *A*) ; size 3μ by 50μ to 8μ by 160μ; a very few of the smallest ones are faintly centrotylote. Second microscleres, oxyspherasters (fig. 15, *I*, *J*, *K*) ; total diameter, 9μ to 25μ, the smaller ones having the more numerous rays.

Remarks.—This species is very sharply set off by the peculiar bicurvates. *P. tyloaster* Dendy, 1924, from New Zealand occasionally has its dermal microscleres twice bent but they are oxea, not strongyles, and the bicurvate form is rare; moreover the asters are tylasters in that species. For further notes see the remarks under *Papyrula saccharis*.

Genus PAPYRULA O. Schmidt

PAPYRULA SACCHARIS de Laubenfels

Papyrula saccharis DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21476; B.M. No. 29.8.22.5.

Type locality.—Collected by me, at Point Pinos, Pacific Grove, Calif., June 29, 1926. Found together with two smaller specimens, lying loose under stones near low-tide mark.

Description.—Shape, massive, rounded. Size, up to 1.5 by 1.5 by 3.5 cm. Consistency, cartilaginous. Color in life and when preserved, white. Oscules, round, with depressed, rounded edges, diameter about 200μ. Pores, of various sizes; some are 65μ to 150μ and perhaps larger. Many openings can not be identified as to whether they are pores or oscules. Surface, superficially smooth.

Ectosomal specialization, a densely felted mass of microxeas, containing also the cladomes of the dichotriaenes; thickness about 100μ. This is not easily detachable. Endosomal structure, "crumb-of-bread," with spicules not very evident; there is much solid matter as compared to cavity. Histological details: The flagellate chambers are spherical, about 30μ in diameter. There are very definite radiating fascicular tracts of diactines; total tract diameter, about 100μ.

Principal spicules, oxeas (fig. 16, *E*, *F*, *G*) ; size ranging up to 22μ by 780μ; some are modified as styles. Ectosomal spicules, dichotriaenes (fig. 16, *B*, *C*, *D*) ; size of clads, 10μ by 120μ to 30μ by 210μ, size of rhabds, 20μ by 320μ to 30μ by 435μ. Microscleres, microxeas (fig. 16, *A*) ; size, 1μ by 35μ to 3μ by 145μ; a very few are microstrongyles and some are bent once or twice; very rarely they are centrotylote.

Remarks.—This species clearly fits *Papyrula*, which differs from *Penares* only in the lack of the astrose microscleres. Three species previously described may be recognized as belonging here: *Papyrula candidata* O. Schmidt, 1868, from the Mediterranean; *P. hilgendorfi* Thiele, 1898, from Japan; and *P. sphaera* Lendenfeld, 1907, from south of the Cape of Good Hope. Add *P. saccharis* and one has four species whose descriptions permit of no sharp contrasts. I do not believe them synonymous, however; rather I should hazard a guess that all four are juveniles of other species, probably belonging to *Penares*, and in this case *Papyrula* Schmidt, 1868, would fall as synonym of *Penares* Gray, 1867. For the present I hold with Wilson (1925, p. 286) in retaining *Papyrula* provisionally. As for the possibility (which I wish to stress) that *saccharis* may prove to be a synonym of *Penares cortius*, I shall make the following comparisons: They differ greatly in color; noticeably but probably not fundamentally, in surface structure; and further in spiculation. *P. saccharis* lacks the asters, has only rare tetraxon spicules, lacks the twice-bent modification of the microdiactine, and has it oxeote rather than strongylote. On the other hand, in view of the closeness in geographical location, one must stress the great similarity of the megascleres of the two species, the general agreement in cortical structure, and the known fact that certain microscleres may be missing at times although quite characteristic of a species.

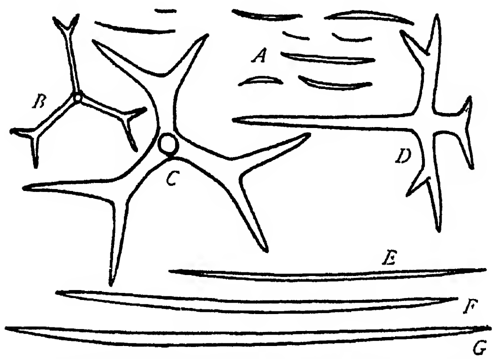

FIGURE 16.—*Papyrula saccharis* de Laubenfels, ×80. Microscleres (microxeas) clustered about *A*; *B–D*, dichotriaenes; *E–G*, oxeas

Genus DERCITUS J. E. Gray

DERCITUS SYRMATITUS de Laubenfels

Dercitus syrmatitus DE LAUBENFELS, 1930, p 26.

Holotype.—U.S.N.M. No. 21438; B.M. No. 29.8.22.20.

Type locality.—Laguna Beach, Calif., March 26, 1929, intertidal. Collected by me, one specimen or group of specimens. Habitat is given more in detail under description of endosomal structure.

Description.—Shape, amorphous. Size, see notes below. Consistency, mediocre. Color in life and when preserved, drab. Oscules and pores, not evident. Surface, superficially smooth.

Ectosomal specialization (?). Endosomal structures: What was collected was a mass of sand held together by some slimy material having an odor like that of a keratose sponge, the only reason for suspecting sponge nature. Microscopic study indicates there really may be keratose sponge present, but not in condition to be described. Here and there in between the masses of sand grains are little areas, about 0.2 to 2 mm in greatest diameter, and very amorphous in outline, that are packed with calthrops and myriads of discasterlike microscleres. No further details can be made out.

Principal spicules, calthrops (fig. 17, *B*, *C*, *D*); size of rays, 3μ by 25μ to 10μ by 80μ; one ray may be missing, leaving triods. The rays are commonly 8μ by 65μ, but one or two are commonly longer than the others. Microscleres, very abundant, discasters (?) or sani-

FIGURE 17.—*Dercitus syrmatitus* de Laubenfels: *A–G*, ×300; *H*, ×1,333; *I–N*, ×1,500

dasters (fig. 17, *H–N*); length, 8μ to 12μ. Some are so irregularly spiny as to resemble acanthomicrostrongyles, but most have two decided nodes, and many resemble the spicule type termed by Dendy (1921, p. 121) as discorhabd.

Remarks.—The previously described species of *Dercitus* are often regarded as all synonymous with the genotype, *Dercitus bucklandi* McAndrew-Bowerbank, 1861 (about p. 235).[2] Its microscleres are about three times as long as those of *syrmatitus* and lack the nodal arrangement that makes those of the latter become discasters. Its megascleres include oxeas, and its calthrops have ray dimensions nearly four times those of *syrmatitus*, so that their mass must be 50 times as great. In fact, the California species seems to show close

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[2] The name *bucklandi*, first used (loc. cit.) as *Halina bucklandi*, may there be a *nomen nudem*, in which case the name should date from its use by Bowerbank, 1866, p. 226, as *Hymeniacidon bucklandi*. *Dercitus* was erected for it by Gray, 1867, p. 542. For the synonymization referred to, see Topsent, 1894.

relationship to the Homoscleophora. Toxas were found in *bucklandi*, and I can report a few in *syrmatitus*, but I consider them in both cases foreign inclusions, as were certainly three chelas of two different sorts, five sigmas, and some broken tylostyles that were in *syrmatitus*.

Family TETILLIDAE Sollas

Genus TETILLA O. Schmidt

TETILLA MUTABILIS de Laubenfels

Tetilla mutabilis DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21498; B.M. No. 29.8.22.33.

Type locality.—Newport Harbor, near San Pedro, Calif., November, 1924, collected by me. The species occurs near, often just below, extreme low-tide mark.

Occurrence.—I know of no specimens of the sponge from any other locality than the mud flats around Balboa Island in Newport Harbor. The massive forms lie loose on the soft mud, the clavate forms seem to have been attached to small shells or other solid objects. In November, 1924, I found the massive form amazingly abundant, mostly sponges the size of a fist or larger, and nearly every square meter had a specimen; there must have been literally bushels in sight.

In June, 1926, a visit to the same locality failed to yield a single specimen, in spite of a careful search at a very low tide, but in November, 1926, the species had again become common. Hard rains occur in this vicinity during winter, and it would seem probable that the great influx of fresh water, which then, but only then, runs into this harbor, would greatly lower the salt content over these flats. A rain at low tide would drench the sponges then exposed.

Description.—Shape, pedunculate-clavate to irregularly massive. Size, up to 8 cm high and 15 cm in diameter. Consistency, moderately spongy to cartilaginous. Color in life, dull red with greenish glints (due to algae ?); dry, gray; in alcohol, dull red. Oscules, oval, flush, about 2 mm in diameter; usually several centimeters apart. Pores, well under 100μ in diameter, very difficult to find. Surface, superficially hirsute with repent, exceedingly thin spicules matted or felted together.

Ectosomal specialization, not evident, other than that mentioned above. Endosomal structure:

I. Structure of clavate form. My largest specimen of this form was 22 mm high and 12 mm in diameter. Those of this form are typically much smaller than that. There is a central axis about 500μ thick, through stem and body, consisting of densely packed

spicules with little protoplasm. In the body this is surrounded by gross chambers 1 to 2 mm in cross section diameter, and much longer in the direction of the axis of the sponge. In one specimen at least there are just four of these, very symmetrically arranged. The outer wall around the above described structure is about 1 mm thick, and like the partitions is packed with felted, interlaced spicules in confusion. The surface, as mentioned above, is thickly studded with protriaenes, clads outward, arranged to a certain extent in brushes but not erect. One may presume the inhalent openings lie between these tufts. The oscule is often apical in this form. Several sponges of this form were collected by the University of Southern California on November 28, 1914 (U.S.N.M. No. 21389) and by myself (the specimens unfortunately were lost) in the autumn of 1923. On both these occasions the massive form was present in greater abundance than the clavate.

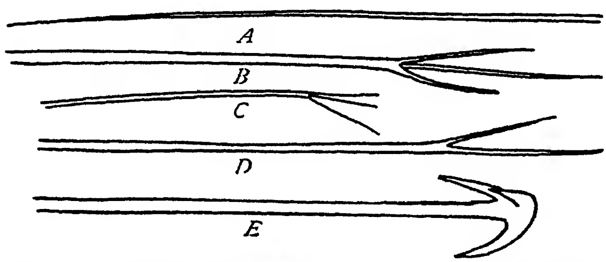

FIGURE 18.—*Tetilla mutabilis* de Laubenfels, ×300. *A*, Either end of the oxeas, or the exactinal end of any of the triaenes; *B–D*, prodiaenes and protriaenes; *E*, anatriaenes

II. Structure of the massive form: Unlike most Tetillas there is no central or radiate skeleton, instead the spicules are matted together in sheets or walls around gross chambers. The surface, as mentioned above, is crowded with brushes of spicules, usually lying almost flat and practically never erect.

Ectosomal spicules, prodiaenes and protriaenes (fig. 18, *B*, *C*, *D*); rhabd diameter, 1μ to 6μ; clad length, 30μ to 90μ; chords, 20μ to 40μ. Endosomal spicules, filiform oxeas (fig. 18, *A*); size 2μ by (?)μ to 9μ by 2,000μ. Auxiliary spicules, anatriaenes (fig. 18, *E*); rhabd diameter, 3μ to 7μ; clad length, 20μ to 30μ; chords, 30μ to 40μ; rare and location in sponge not certain.

For all the above spicules, it will be noted there are few data as to total lengths. This follows from the fact that in spite of utmost care, it seems impossible to mount total spicules for this species. They are not only exceedingly thin, long, and brittle, but also are so interlaced that in disengaging any they are inevitably broken. I should estimate that they were frequently over a centimeter long and perhaps 2 or 3 cm.

Remarks.—The lack of spicules thicker than 9μ is one of the most distinctive features about *mutabilis*, the great rarity of the anatriaenes perhaps even more so. The most of the species of this genus have strongly radiate architecture, sigmoid microscleres, and papillate surface.

Although it is found concurrently with the massive form, I incline to believe the clavate form the juvenile of the massive. It is strongly suggestive of *Tetilla radiata* Selenka (1879, p. 467), from Rio de Janeiro, which also lacked microscleres, and is probably its closest relative.

TETILLA ARB de Laubenfels

Tetilla arb DE LAUBENFELS, 1930, p. 36.

Holotype.—U.S.N.M. No. 21496; B.M. No. 29.8.22.44.

Type locality.—Pescadero Point near Carmel, Calif., July, 1925, intertidal, collected by the author. Numerous specimens were examined, all from central California, as this is a rather common species there. It grows usually on the under sides of overhanging rocks, but I found one specimen lying unattached under a bowlder.

Description.—Shape, subspherical. Size, up to 5 cm high, 8 cm in diameter. Consistency, firm, cartilaginous. Color in life and when preserved, drab. Oscules, diameter about 3 mm; surrounded by a palisade of densely packed spicules. Pores, not evident. Surface, superficially hirsute, with a spicule plush about 3 mm high.

Ectosomal specialization, corticate, 0.5 to 1.4 mm thick. I see no fibers in it, no tangential spicules, but abundant microscleres. Most of the spicules that project beyond it seem to be protriaenes. They might be considered as chiefly cortical. The outer portions of the cortex contain many cells with conspicuous dark granules. Endosomal structure, cartilaginous, crowded with radially arranged spicules. The axial region is almost solid spicule. Histological details: As is common, the cells proper are well under 15μ in size. There are present, scattered in the flesh of at least one of the specimens of *Tetilla arb*, large bodies about 60μ by 100μ in cross section, resembling cells. These may be large ova or small embryos.

First spicules, filiform oxeas (fig. 19, *B*, *C*); size 9μ to 50μ in diameter; length certainly several millimeters, probably 2 or 3 cm. Second spicules, anatriaenes (fig. 19, *D*, *E*); chords, 50μ to 90μ; rhabds, usually but 6μ to 12μ in diameter; length, probably more than 10 mm. Their cladomes usually lie just below the surface. Third spicules, protriaenes (fig. 19, *F*, *G*, *H*, *I*); chords, 8μ to 30μ rhabd diameter, 2μ to 12μ; length up to at least 32.4 mm as based on one of which I was able to make accurate measurement. In the sponge they are so densely packed it is difficult to say where one begins and another ends; disengaged they are usually broken.

Maximum lengths are probably more than 5 cm. Many of the spicules seem to reach from the center of the sponge to a point several millimeters past the surface of the sponge, from which circumstance one is led to conclude that they may continue growth as the sponge enlarges, and that this increment must be added only at the deeply embedded end. Microscleres, spiny sigmas (fig. 19, *A*, *J–O*); length, 7µ to 9µ, located throughout the sponge. Only with oil immersion can they be seen to be microspined. One end is often slightly tylote; sometimes both ends are. This spicule need only have somewhat large spines to become a spiraster.

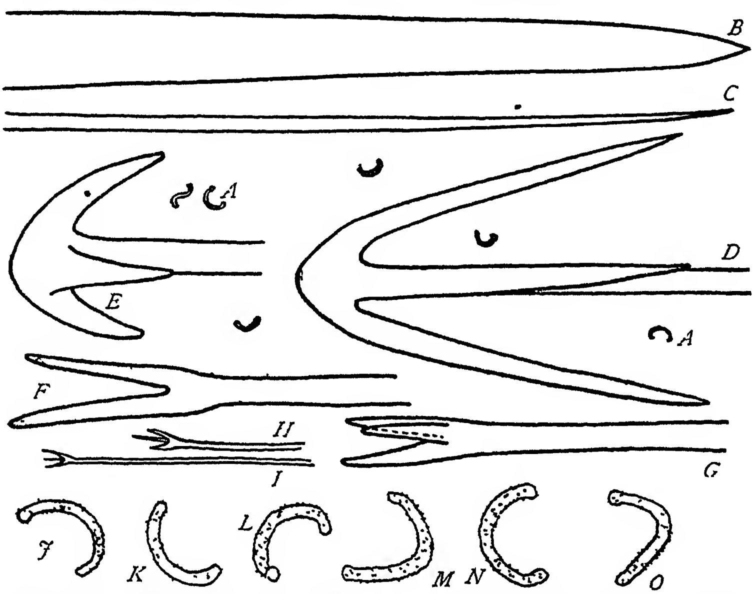

FIGURE 19.—*Tetilla arb* de Laubenfels: *A–I*, ×300; others, ×1,333. *C*, termination of the more slender sort of oxea, and of the esactinal ends of the triaenes

Remarks.—Lambe (1893, pp. 34, 35), records two Tetillas from the vicinity of Vancouver Island, but neither seems at all close to the California species. Both the Canadian forms had the special dermal oxea for which certain recent authorities (see George and Wilson, 1921) would retain *Craniella;* their placement and size of spicules are also consistently different. For example, *T. spinosa*, the one of more southerly distribution of the two, has its megascleres in a whorled or spiral placement, and microscleres half again as long as in *T. arb*. For both of Lambe's species he mentions no spines on the microscleres, nor the tylote endings, but his figure for *T. spinosa* seems to show such. Both his species have conspicuously villous or conulose surfaces, strikingly absent in the California forms.

I agree with all recent writers in merging *Tethyopsilla* with *Tetilla*, from which it differed only in lack of microscleres. It is

very evident that microscleres are easily lost. I also merge *Craniella*, because of the difficulty of being sure whether one has a special type of oxea in the ectosome. Lambe seems confident his species are so supplied. There may be such in the California forms, but in such small numbers that they are overlooked; further, rather smaller oxeas do occur in the interior of the sponge most certainly; and still further, all the *Tetilla* megascleres are so easily broken that the whole problem of identification of special categories is most difficult. From many published descriptions one can not be sure that each *Tetilla* is not perhaps a *Craniella*. The two groups are so similar in other respects that their combination seems to me most advisable. *Cinachyra*, on the other hand, seems a well-marked genus, and the interests of convenience would appear served by its retention. This leaves about 71 species for *Tetilla*, all of which are very like one another. They have almost identical megascleres and general plan. The principal differences are in ectosomal structure, and in the microscleres. The latter are so small that some earlier workers with poor microscopical equipment may have described them inadequately. I find very few other species with the thin, even ectosomal structure, and none with well-described microscleres exactly like those of *T. arb.*

Order HADROMERINA Topsent

Family TETHYIDAE Gray

Genus TETHYA Lamarck

TETHYA AURANTIA (Pallas) CALIFORNIANA, new variety

Holotype.—U.S.N.M. No. 21495; B.M. No. 29.8.22.15.

Type locality.—Pescadero Point, near Carmel, Calif., July 25, 1926, intertidal, collected by the author. Numerous other specimens were examined, especially in the collections dredged by the University of Southern California (U.S.N.M. Nos. 21390, 21411, and 21415), from shallow water in southern California. There is frequently a dense coating of diatoms and green algae over the surface of this variety.

Description.—Shape, hemispherical to ovate-stipitate. Size, up to 5 cm high, 3 cm in diameter. Consistency, moderately spongy. Color in life, yellow; preserved, it is drab. Oscules, not evident. Pores, not evident. Surface, superficially warty with mushroom-shaped elevations about 2 mm high, crowded over the upper portion.

Ectosomal specialization, cortical, about 1 mm thick. Endosomal structure, fleshy, permeated by radiate fascicular tracts. Principal, or ascending, tracts 250μ to 800μ in diameter, packed with spicules, the more pointed end usually toward the surface.

Principal spicules, fusiform strongyles (fig. 20, *A*); size, 6μ by 500μ to 40μ by 3,000μ. Secondary spicules, tylostrongyles (not figured); size, about 30μ by 1,300μ. First microscleres, spherasters (fig. 20, *B*, *D*, *E*, *F*); diameter, up to at least 66μ. Second microscleres, tylasters (fig. 20, *C*, *H*, *I*, *J*); diameter, up to at least 27μ. Third microscleres, much smaller asters (fig. 20, *G*); size, diameter about 8μ; these may be juvenile stages of either of the two preceding sorts.

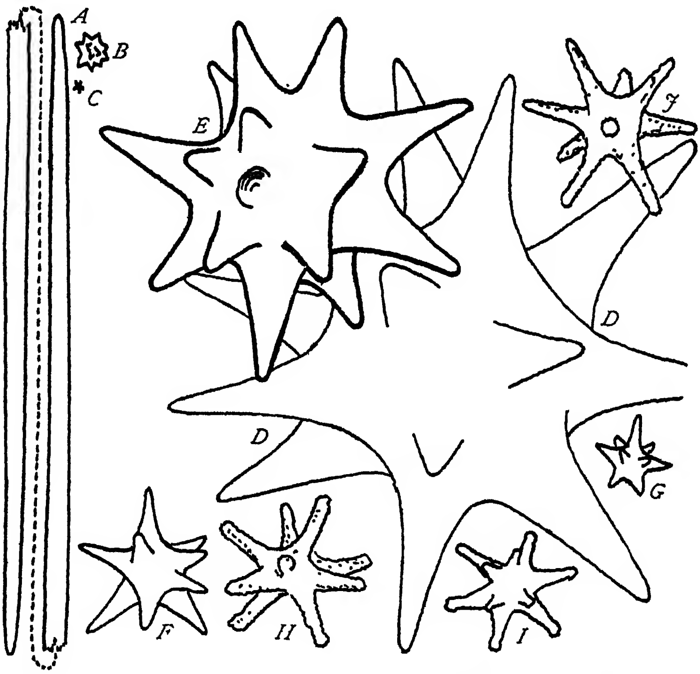

FIGURE 20.—*Tethya aurantia* (Pallas) *californiana*, new variety; *A–C*, ×80; others, ×1,333

Remarks.—This form is very close to the type variety, which is European (first described after 1758 as *Alcyonium aurantium* by Pallas, 1766), from which it differs in larger average spicule size and preponderance of the strongyle instead of style among the megascleres.

Family TIMEIDAE Topsent

Genus TIMEA J. E. Gray

TIMEA AUTHIA de Laubenfels

Timea authia DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21499; B.M. No. 29.8.22.22.

Type locality.—Laguna Beach, Calif., March 14, 1926, intertidal, only one specimen, collected by me.

Description.—Shape, amorphous, massive, encrusting. Size, 2.5 mm thick, 3 or 4 cm in diameter. Consistency, mediocre, spongy, fragile. Color in life, orange; preserved, drab. Oscules, not evident. Pores, not evident. Surface, superficially between smooth and minutely tuberculate.

Ectosomal specialization, a dermal membrane about 80μ thick, not detachable, containing characteristic dark cells. Endosomal structure, fleshy; the canals are few and inconspicuous, asters are very abundant, and there are scattered tracts as described below. At the surface the tracts spread into terminal brushes. Principal, or ascending, tracts 100 to 125μ in diameter, consisting of densely

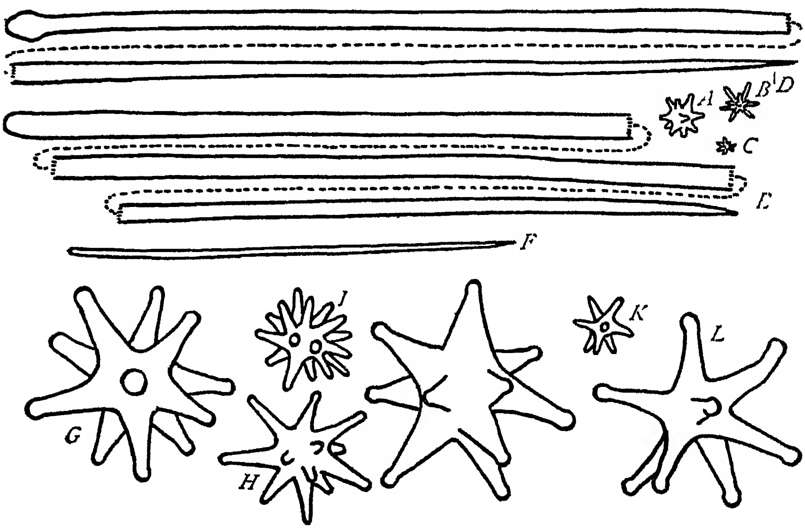

FIGURE 21.—*Timea authia* de Laubenfels. *A–F*, ×300; others, ×1,333

packed monaxons, points upward. These tracts ascend to the surface at an angle. They are about 600μ apart.

Principal spicules tylostyles (fig. 21, *D*); size, about 10μ by 770μ. Secondary spicules, styles (fig. 21, *E*, *F*); size, 4μ by 200μ to 11μ by 840μ. Microscleres, tylasters (figs. 21, *A*, *B*, *C*, *G–L*); diameter, 6μ to 23μ, located throughout the sponge. These spicules vary from smooth to minutely roughened. Some have 20 to 30 rays, others 10 or less. Some are so enlarged at the base that the appearance is of spherasters, others clearly have no centrum. The tylote termination seems consistently present.

Remarks.—*Timea* Gray (1867, p. 544), type *T. stellata*, receives as synonym *Columnitis* Schmidt (1870, p. 25), type *C. squamata*, and both are often merged in further synonymy with *Tethya*. After a study of the California specimens of each, I feel it most accurate to retain *Timea* and *Tethya* separate. Local conditions are so very

favorable to the encrusting form that almost every sponge here is encrusting, yet our Tethyas are at least massive and hemispherical. The sponges properly referable to *Timea* seem to be merely encrusting in whatever part of the world they occur. The typical spicule in *Tethya* is a fusiform strongyle, which varies toward being a tylostrongyle or style, but is very large, usually around 25μ by 2,000μ. The principal *Timea* spicule is a sharp-pointed, large-headed tylostyle, about 10μ by 500μ to 800μ. The principal microsclere of *Tethya* is a very large spheraster, usually about 75μ in diameter. The asters of *Timea* are characteristically well under 25μ in diameter.

Timea as here understood comprises beside *T. authia* at least the following:

Hymedesmia stellata Bowerbank (1866, p. 150), from Great Britain, with tylostyles about 10μ by 500μ and strongylasters all about 13μ in diameter.

Columnitis squamata Schmidt (1870, p. 25), from the West Indies, with tylostyles and with tylasters, oxyasters, and roughened strongylasters. Schmidt gives no spicule measurements but from his figure one can deduce the megascleres are well under a millimeter long.

Donatia parasitica Higgin (1877, p. 5), from the West Indies, with tylostyles 7μ by 500μ, rough tylasters 12μ, and spherasters (?) 25μ.

Timea tetractis Hentschel (1912, p. 322), from the south Pacific with tylostyles up to 7μ by 520μ, strongylasters up to 12μ, and roughened oxyasters with very few rays, 15μ to 31μ.

Family CLIONIDAE Gray

Genus CLIONA Grant

CLIONA CELATA Grant CALIFORNIANA, new variety

Holotype.—U.S.N.M. No. 21437; B.M. No. 29.8.22.52.

Type locality.—Pacific Grove, Calif., February 7, 1929, intertidal, boring in the shells of dead barnacles.

Additional material examined.—The species is moderately common in the shells of *Haliotis rufescens* that are collected near Monterey at depths of 1 to 20 meters.

Description.—Shape, amorphous, boring, making tunnels about 1 mm in diameter, and proliferating out of them in masses. Size, the masses are well over 10 mm in diameter. Consistency, mediocre. Color in life, yellow; preserved, drab. Oscules, minute; on papillate projections in the boring form. Pores, minute; on papillate projections in the boring form. Surface, superficially smooth, but not even, very irregular.

Ectosomal specialization, insignificant. Endosomal structure, fleshy, with spicules in confusion.

Principal spicules, tylostyles (fig. 22); size 2μ by 200μ to 9μ by 270μ.

Remarks.—The nearest relative of this form seems to be the type species, which is European. The variety *californiana* differs in having spicules that average about one-fourth smaller than those of the European form, and in lacking the spicules (often found in the type variety) in which the head is so reduced that they are merely styles, not tylostyles. Furthermore, I can not record the small oxeas

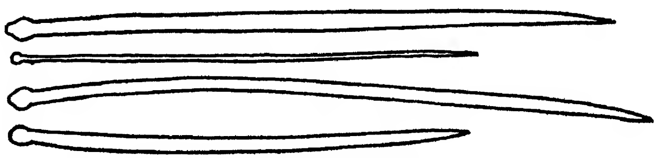

FIGURE 22.—*Chona celata* Grant, ×300

and spirasters of the type variety, but this has no significance taxonomically, because they often can not be found even in European specimens, being normally scarce and easily overlooked.

Genus SPHECIOSPONGIA Marshall

SPHECIOSPONGIA CONFOEDERATA de Laubenfels

Speciospongia confederata DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21487; B. M. No. 29.8.22.50.

Type locality—As noted below, there was a large mass of this sponge at Point Pinos near Pacific Grove, Calif.; the holotype was taken from it.

Description.—Shape, massive. Size: The largest specimen is only about 12 cm in diameter, but the mass in the field was 14 cm thick and 70 cm in diameter, with a central hollow where lay two large sea urchins (*Stongylocentrodus franciscanus*); it would seem that the sponge grew around them. This was among granite bowlders, exposed to violent wave action, and out of water only at very low tides. This or a similar mass had been there four years that I know of, and longer according to Prof. W. K. Fisher. It had become appreciably larger throughout the years, but the exact rate of growth can not be given. Consistency, firm, slightly compressible. Color in life: Under water, creamy gray; out of water, dull, purplish leaden gray; in an aquarium the pore areas became lavender, the rest of the surface yellow. On subsequent days the appearance of the pore area was frequently rich brown, on account of coatings of diatoms apparently fil-

tered out of the running sea water. These coatings were washed off by a stronger current directed across them. The second day in the aquarium, areas adjacent to the cuts made in detaching the specimen turned dull brown, as did bits plunged in formalin. On this day the areas formerly lavender were clear blue. On the third day in the aquarium the yellow areas were more ochraceous than before. The oscules still opened and closed vigorously. On the sixth day the latter evidence of vitality was still in evidence, but on the seventh the oscules were closed and remained closed. On the twelfth day there was still no odor of putrefaction, but a funguslike growth, or filamentous bacteria, attacked the cut areas. On the thirteenth day the entire specimen was a dull drab and was dead or nearly so. The dried specimen became dull yellow, the alcohol specimen, dull brown. Oscules, largely grouped on the summit, and when fully open nearly 10 mm in diameter. They are very readily closed by sphinctrate tissue about them. Into many of them hung fleshy, membranous sleeves, of very perplexing function. Why they did not act as valves and close the oscule is a mystery. Perhaps in life, with a strong current, they project as oscular chimneys; if so, they would protrude 2 or 3 cm. The aquarium specimen showed no strong oscular current, but much evidence of strong inhalent current. This is probably because the exhalent current had much larger exit at the cut surface than at the oscules. There were amoeboid cells and a few spicules scattered in the otherwise homogeneous structure of these membranous sleeves. Pores, in pore areas several centimeters square. The pore canal is typically 1.5 to 3 mm. in diameter. It is closed on the surface by a sieve with 3 to 6 round openings about 300μ in diameter. In the area between the pores and the oscules were a few scattered round openings about 1 mm in diameter. I could not determine whether they were inhalent or exhalent. Surface, superficially smooth.

Ectosomal specialization, the surface for a depth of about 2 mm is densely packed with spicules, the outer ones arranged points outward as in *Suberites*, but they are not smaller than the endosomal spicules. Endosomal structure, resembling nonboring examples of *Cliona*, with some very large cloacal canals nearly 1 cm in diameter, and with woody tracts of spicules about 2 mm in diameter making a vague reticulation.

Spicules, tylostyles (fig. 23); size, 14μ by 300μ to 13μ by 310μ. A very few are much thinner and somewhat shorter, these are evidently developmental stages. The uniformity in size of the spicules in general is very remarkable.

Remarks.—Lamarck (1815, p. 78) described *Alcyonium vesparium*. I have examined his specimens at the Paris Museum and unhesitatingly identify them with a common West Indian species with which I have had much field experience. His type specimen was of dubious locality, but his other two were clearly labeled as West Indian. This species can be readily recognized by the peculiar structure of its pores.

I found specimens clearly of this species labeled *Suberites* in the Berlin Museum. I heard of French specimens labeled *Hardwickia*. It is probably the species referred to by Duchassaing and Michelotti (1864, p. 85) as *Thalysias vespara*. Bowerbank (1872, p. 126) described it as *Hymeniacidon pulvinatus*. I have seen his specimens in the British Museum, and they are clearly *vespara*. Schmidt (1870, p. 48), described it as *Papillina cribrosa*. I have studied his type at Strasbourg and there is no question about it. Carter (1879, p. 348)

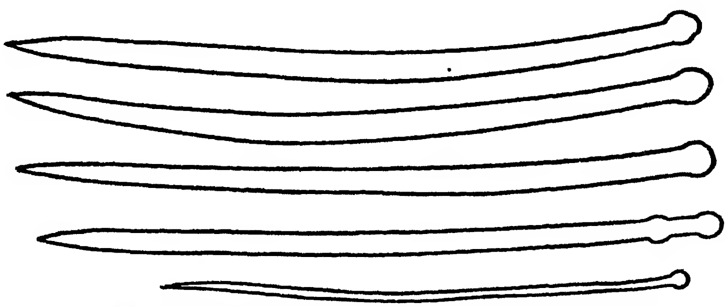

FIGURE 23.—*Spheciospongia confoederata* de Laubenfels, ×300

referred to this species (from Bowerbank's specimen) as *Spongia dysoni*. Marshall (1892, p. 32) made it the type of a genus *Spheciospongia* for its peculiar pore structure, basing his work on Lamarck's specimens. Verrill (1907, p. 342) made it the type of a genus *Heterocliona*, using Schmidt's description. George and Wilson (1921, p. 135) described it as *Spirastrella andrewsi*, and later (p. 139) as *Poterion atlantica*. I have studied the specimens in the United States National Museum and am positive of the identification. (All the specimens are labeled *Spirastrella andrewsi*.) There is so much resemblance to Bowerbank's genus *Raphyrus* that one is tempted to call this *Cliona*, except for the lack of evidence, even in the smallest youngest specimens, of any boring ability or tendency, and for the peculiar pore structures. Two genera that are probably not valid, but that might have been used here, are *Osculina* and *Rhaphiophora*; nevertheless, the list of generic designations is rather complete, at least 10 or 11 having been employed.

This species is of peculiar interest because it is the largest sponge in the world. I have frequently found examples nearly a meter in diameter and they are on definite record as of nearly 3 meters in diameter.

The Californian representative of this remarkable genus (*Spheciospongia confoederata*) resembles *vespara* in many ways. It is significant that it is one of our largest local sponges. The species *vespara* has the same most remarkable kaleidoscopic color changes, and the same architecture, but differs in having a few dermal spirasters in some specimens and in having (at least in mature specimens) much coarser pore structure.

Many species described as *Spirastrella* are probably rather closely related here. Other relatives are incorrectly described as *Suberites*, which is properly a genus of compact, nonfibrous sponges with a special dermal armor of outwardly pointing tylostyles smaller than those of the endosome.

Family POLYMASTIIDAE Vosmaer

Genus POLYMASTIA Bowerbank

POLYMASTIA PACHYMASTIA, new species

Holotype.—U.S.N.M. No. 22062; B.M. No. 30.10.8.5.

Type locality.—The holotype was collected by me at Point Lobos, south of Carmel, Calif., intertidal, July 12, 1930. A second specimen, presented to Prof. Harold Heath, of Stanford University, was trawled near Point Sur by a fisherman, August 20, 1929, depth not known.

Description.—Shape, massive with digitate protrusions 7 to 10 by 170 mm. The holotype was about 2.5 cm in diameter, with 3 fistules; the second specimen was about 3 by 6 by 6 cm, with 14 fistules. Consistency, woody. Color in life, bright yellow. No oscules were in evidence, and the pores were closed. The surface of the fistules was smooth, but that of the main mass was coarsely hispid.

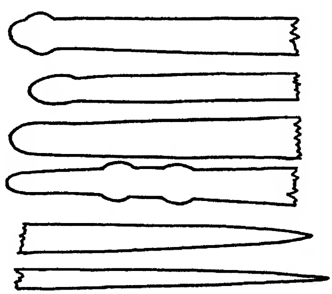

FIGURE 24.—*Polymastia pachymastia*, new species, ×300. Only heads and points of spicules are shown.

Ectosomal specialization, in the form of a cortexlike rind, 1.5 mm thick and densely packed with spicules both perpendicular and parallel to the surface. It contains the extremities of the fascicular columns, and there are smaller tylostyles in their terminal brushes, points outward. Over the main mass of the sponge a spicule fur

projects about 1 mm beyond the surface. Endosome, a fleshy basis permeated by radially arranged fascicular columns of spicules, the entire column being approximately 200μ in diameter.

The spicules are chiefly tylostyles, of all sizes up to 7μ in diameter by 2,000μ or more in length. Some are merely styles, and in others the globular swelling is not quite at the head of the spicule. These tylote swellings may be multiple, two or more to the spicule.

Remarks.—The present species is remarkable for the very short, large fistules. Within the genus *Polymastia* they are much longer and thinner as a rule than in *pachymastia*, and they often have an oscule at the distal extremity. It is probable that these projections are in all cases to be regarded as sieves protecting the exhalent apertures from invaders. In the walls of the fistules the tracts crisscross to make gratings, in some cases in very regular patterns. *P. pachymastia* is also marked off from most members of the genus by the very great length of its spicules and by the relative scarcity in its ectosome of shorter tylostyles.

Family SUBERITIDAE Gray

Genus FICULINA J. E. Gray

FICULINA SUBEREA (Johnston) LATA (Lambe)

Suberites latus LAMBE, 1892, p. 71.
Suberites suberea LAMBE, 1894, p. 126.

Holotype.—In the Museum of the Geological Survey, Ottawa, Canada.

Type locality.—The west coast of Canada.

Material examined.—One specimen (U.S.N.M. No. 21443; B.M. No. 29.8.22.51) was found in the wrack at Asilomar, near Pacific Grove, Calif., July, 1925; another was dredged by the University of Southern California, September 24, 1924, from 36 meters, south of the breakwater at San Pedro (U.S.N.M. No. 21396).

Description.—Shape, massive, subhemispherical. Size, 3 cm in diameter. Consistency, firm, slightly compressible. Color in life, bright orange; preserved, pale drab. Oscules, not evident. Pores, not evident. Surface, superficially smooth.

Ectosomal specialization: Smaller spicules that are otherwise like the endosomal ones are packed together—points outward and in a (curved) plane, heads not so even because of variations in spicule length. Endosomal structure, fleshy, with spicules in confusion. There is a high ratio of solid matter as compared to cavity.

Principal spicules, tylostyles (fig. 25), size, 5μ by 70μ to 12μ by 590μ.

Remarks.—The nearest relative of this form seems to be the type variety, which is British and which differs in having spicules that

average smaller and in being normally red or white rather than golden.

Lambe, 1892 (p. 71), described *Suberites latus* from the west coast of Canada. In 1894 (p. 127), he redescribed his specimens, identifying them as *Suberites suberea* Johnston. Since our Californian specimens agree with his in having consistently larger average size of spicules than the British form, it seems wise to retain Lambe's original designation as subspecific. Topsent in 1900 referred Lambe's species to *Ficulina.*

Suberites dates from Nardo (1833, p. 523), and was based on *domunculus* of Olivi, a well-known Mediterranean form. *Ficulina* dates from Gray (1867, p. 523), and was based on *ficus*, a well-known British form. The name *ficus* was employed by Pallas (1766, about p. 356), but his description and locality reference show clearly

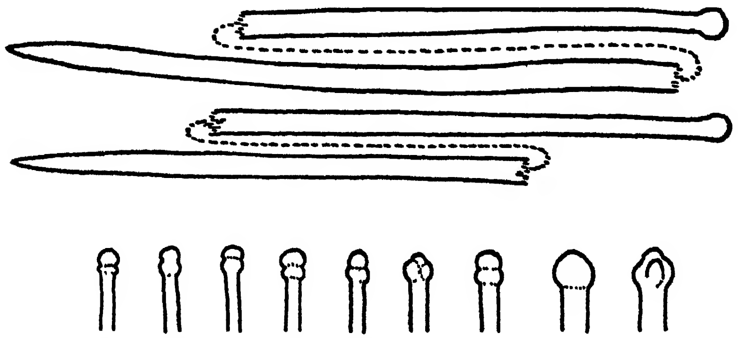

FIGURE 25.—*Ficulina suberea* (Johnston) *lata* (Lambe), ×300. Three complete typical spicules, and the heads of nine others to illustrate variations, are shown

that he referred by the name both to *domunculus* and the British form. See also Linnaeus, 1767 (p. 1295). The first species name that I find clearly applicable to the British sponge is *suberea* Montagu, 1818. The literature separates *Ficulina* from *Suberites* chiefly by the peculiar microscleres (centrotylote microstrongyles) of *Ficulina*, but these are so very frequently not in evidence that I made a careful study based on fresh material at Plymouth (of *suberea*) and at Naples (of *domunculus*) to obtain as much data as possible on their distinction in the absence of microscleres. I will tabulate some such distinctions:

1. *Consistency.*—All 16 of my specimens, undoubtedly *suberea*, shrunk notably on drying; none of my four *domunculus* did. Consistencies in life and in spirits were otherwise very similar between the two species.

2. *Color.*—My observations and the literature show the ordinary color range of *domunculus* to be from white to vermilion, with

orange most common; grays and blues occur. Similar data show the normal range for *suberea* white to crimson, with grays and rosy pinks predominating.

3. *Oscular closing.*—In all four of my specimens, undoubtedly *domunculus*, the numerous oscules closed to a line, not to a point. It is odd that this is not mentioned in the literature; can it be that all four were unusual? This seems unlikely, and I presume this may be a valuable indication when one has fresh material.

4. *Spicules.*—Those of *suberea* are large-headed tylostyles, with the double-headed modification very common. Those of *domunculus* are small-headed, so that they approach styles in appearance, and double-headed modifications are uncommon. The species *suberea* often has microscleres; *domunculus*, never. I consider the megasclere shape very important.

Lambe found the *Ficulina* miscroscleres in his material. I did not find them in the Californian specimens, but on the basis of the tylostyle shape alone would feel confident I had *Ficulina*. Of course, it might be decided to merge *Ficulina* and *Suberites*, but I can not see that adequate benefit would result from such fusion at present.

Genus PROSUBERITES Topsent

PROSUBERITES SISYRNUS de Laubenfels

Prosuberites sisyrnus DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21413; B.M. No. 29.9.30.12.

Type locality.—South of the breakwater, San Pedro, Calif., dredged by the University of Southern California at 45 meters, April 5, 1924.

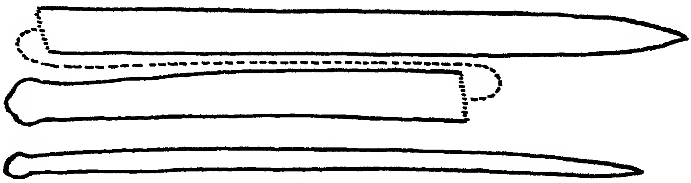

FIGURE 26.—*Prosuberites sisyrnus* de Laubenfels, ×300

Additional material examined.—The University of Southern California also collected a specimen on March 31, 1915, near Catalina Island, and possesses a third without data. On the same date and at the same locality as for the type, but at 54 meters, the University of Southern California collected another specimen, which is so very poorly preserved that it is but a mass of fragments, but from the spiculation it seems probably conspecific.

Description.—Shape, encrusting. Size, actually probably only 1 or 2 mm thick, but so copiously surrounding small worm-tubes,

algae, and similar substrates that considerable masses result. Consistency, mediocre. Color in alcohol, drab. Oscules, not evident. Pores, not evident. Surface, superficially velvety, with hispidation about 300μ high.

Ectosomal specialization, erect tylostyles, points upward. These are not conspicuously of a smaller size range than the deeper-placed spicules. Endosomal structure, very scanty, in places wanting; where present, of confused nature.

Principal spicules, tylostyles (fig. 26); size 8μ by 275μ to 20μ by 480μ.

Remarks.—*Prosuberites sisyrnus* has spicules very much shorter than those of *P. longispinus* and *rugosus* and very much thicker than those of *P. epiphytum*. The genus *Prosuberites* Topsent, 1893, tends to merge into *Laxosuberites* Topsent, 1896, and into *Suberites* Nardo, 1833, all being in a group that much needs revision.

Genus SUBERITES Nardo

SUBERITES GADUS de Laubenfels

Suberites gadus DE LAUBENFELS, 1926, p. 571.

Holotype.—U.S.N.M. No. 21489; B.M. No. 28.11.6.3.

Type locality.—Near Pacific Grove, Calif., taken from a depth of about 30 meters. A fisherman brought up the single specimen entangled in his line.

Description.—Shape, a branched cylindrical stem with enlarged clavate terminations. Size of specimen, about 30 cm high, lobes about 2 cm in diameter and 10 cm long; the stem is about 6 mm in diameter. Consistency, mediocre. Color in alcohol, nearly white. Oscules, with rims; diameter, 1.5 to 2 mm; very irregularly scattered, but about 4 or 5 to the lobe. Pores, at least 150μ in diameter. Surface, superficially smooth.

Ectosomal structure, 1.5 to 2 mm thick; cartilaginous; bluish white in contrast to yellowish white of the endosome. The ectosome is densely packed with spicules perpendicular to the surface, points outward and all at about a level, so that the longer spicules run deeper down into the sponge. There is some tendency for the dermal spicules to be arranged in brushes. Endosomal structure: The stem consists of a dark-brown central axis of densely packed longitudinally placed spicules intermingled with dark granules not certainly, but probably, cellular. Around this extends the ectosome just as over the lobes. As the lobe proper is reached one finds the appearance of choanosome (between the stem and ectosome), which widens until it is about 6 mm thick. The prolongation of the stalk in the lobe neither increases nor diminishes in size, but becomes paler and paler, with more and more choanosome and fewer and fewer spicules. One

can not say exactly where it ends. I find no tendency for it to spread out fanlike. In the choanosome are relatively large and rather few spicules. Histological details: The flagellate chambers are round, diplodal, 40μ to 50μ diameter.

Principal spicules, dull-pointed tylostyles (fig. 27); size 10μ by 200μ to 50μ by 1320μ.

Remarks.—One finds a tendency to pedunculate form very common in *Ficulina suberea.* It is therefore to be expected in *Suberites.* A species having very similar shape to that of *gadus* is described by

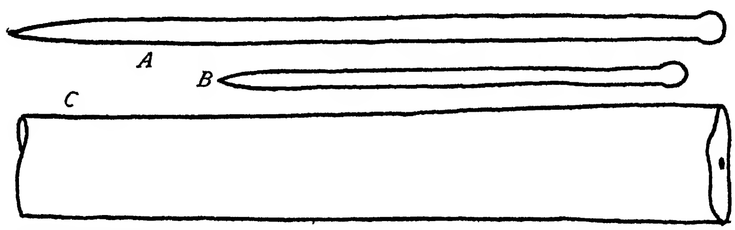

FIGURE 27.—*Suberites gadus* de Laubenfels, ×300. *A* and *B* show size for the smaller spicules, and shape for all; *C*, portion of the shaft of one of the larger spicules, illustrating its proportionate size to the smaller ones

Wilson (1925, p. 352) as *Rhizaxinella nuda*, from the Philippines. It was more brownish than *gadus*, had spicules about half again as large as those of *gadus* and with sharper points, and its stem lacked the ectosomal crust. The two are doubtless closely related.

Order HALICHONDRINA Vosmaer

Family AXINELLIDAE Ridley and Dendy

Genus HALICHONDRIA Fleming

HALICHONDRIA PANICEA (Pallas)

Spongia panicea PALLAS, 1766, p. 388.
Halichondria panicea JOHNSTON, 1842, p. 114.

Holotype.—Location unknown.

Type locality.—Europe.

Material examined.—Specimens were collected at Point Pinos, Pacific Grove, Calif., intertidal, on January 24, 1929, by J. E. Lynch, who reported it then plentiful. During the summer months it has been very rare or lacking, though on July 14, 1929, I found a small specimen at the same locality as that given by Mr. Lynch. In European waters this sponge is very abundant intertidally, and the same or a very similar species is reported from nearly every part of the world's coastal regions that have been well studied.

Description (U.S.N.M. No. 21447; B.M. No. 29.8.22.9).—Shape, amorphous, encrusting. Size, up to 6 mm thick, 3 cm in diameter.

Consistency, fragile. Color in life, orange to green; preserved, nearly white. Oscules, raised; diameter, about 1 mm. Pores, minute. Surface, superficially smooth to tuberculate.

Ectosomal specialization strongly marked, consisting of a dermal crust, about 200μ thick, of tangentially strewn spicules, not differing, however, from those of the endosome. This is underlaid by such extensive subdermal cavities as to be rather readily separable. Endosomal structure, "crumb-of-bread," most of the spicules strewn without order in the flesh, but there may be spicule tracts in a groundwork that is not reticulate. Histological details: I find spherical flagellate chambers 30μ to 40μ in diameter. Principal, or ascending, tracts about 45μ in diameter.

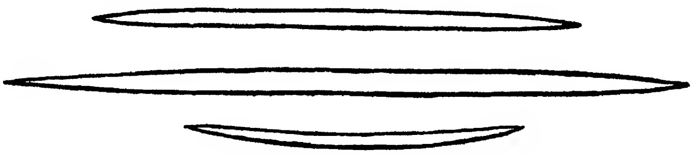

FIGURE 28.—*Halichondria panicea* (Pallas), ×300

Principal spicules, oxeas (fig. 28); size up to 11μ by 300μ. As is characteristic of the species and genus, there is no definite size range of spicules at all, but all sizes—from the largest down—are found intermingled in confusion.

Remarks.—In species so lacking in positive characters as this, it is difficult to be certain whether the similar specimens from various parts of the world are conspecific.

Genus HYMENIACIDON Bowerbank

HYMENIACIDON SINAPIUM de Laubenfels

Hymeniacidon sinapium DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21456; B.M. No. 29.8.22.21.

Type locality.—Newport Bay (near San Pedro), Calif.; intertidal.

Occurrence.—This species is abundant along the rocky, surf-beaten portions of the coast of southern California at nearly every point I have visited. It is the most abundant sponge on the oyster beds in Newport Bay, where the water often becomes quiet and very warm. It is found in various places up the stream that enters the bay, where it must be in brackish water at low tide during rainy weather. It grows even where the water is almost opaque with suspended mud, where at low tide it is exposed to the very ardent rays of the southern California sun, and where it is always chilled by the very cool waters of the open ocean. I have vainly sought any difference in spicules, form, color, or any other quality that varied as a factor of any of these environments.

In the vicinity of Monterey *H. sinapium* occurs very rarely, if at all, though similar ecological situations are found. E. F. Ricketts collected a specimen, July 24, 1926, in a tide pool near Hopkins Marine Station, which was like the southern California specimens in all ways save one; it has spicules up to 14μ by 380μ. Having but the one specimen I hesitate to denominate this a new variety, though in no southern California specimen do I find spicules so large. The condition of the specimen is such that any identification of it must be provisional.

U.S.N.M. No. 21395 represents the only sponge from lower than intertidal zone that I can refer to *sinapium*. It deserves special mention, as its spicules are notably smaller, namely, but 6μ by 205μ at the largest, 5μ by 195μ for an average of apparently mature styles, but with only a few of the very small presumably developmental forms. It was dredged by the University of Southern California in 5 meters near Seal Beach (near San Pedro), just offshore from locations where *sinapium* is abundant intertidally. Is the small spicule size an ecological modification, or is this a different species? Its resemblance to my Plymouth specimens of *H. caruncula* merits comment. Having but the one specimen, no positive decision can be made, but my opinion is that it is an aberrant individual of a species normally intertidal, perhaps modified by the environment. This species is found associated with oysters more than any other one large organism. Numerous other specimens were examined.

Description.—Shape, amorphous to massive to encrusting, often with digitate processes. Size, up to about 10 cm high, 20 cm in diameter. Consistency, very soft. Color in life, bright yellow, sometimes with orange tints; preserved, drab. Oscules, often on raised processes; diameter, about 2 mm. Pores, minute, very contractile. Surface, superficially smooth, with scattered low conules less than 1 mm high.

Ectosomal specialization in the form of a thin, transparent, fleshy dermis. It contains but few spicules. Endosomal structure, "crumb-of-bread," with spicules mostly in confusion, but here and there organized into tracts, mostly directed vertically, points of the styles up. These tracts expand distally into subdermal brushes in a manner that may be described as axinellid, but is also found in most Mycales and some Biemnas, and may indicate axinellid relationships for those genera.

Principal spicules, styles (fig. 29); size up to 9μ by 340μ, with moderately numerous smaller forms.

Remarks.—It is doubtful whether this is a new form, but as it seemed impossible to be absolutely positive of identifying it with any of the known species I applied a distinctive name to it so that

it might be referred to recognizably in future revision. This action may be better understood after noting the following considerations:

In 1827, Grant described *Spongia sanguinea*, a thin, blood-red sponge. It was probably not just one species but several having similar color and styles as megascleres. Grant lacked microscopic equipment adequate for the discovery of microscleres. In 1828, Fleming (p. 521) referred this to his genus *Halichondria*. In 1842 (p. 134), Johnston so identified specimens he had that were preserved in the British Museum. He also gave figures and a fairly good description. Practically the only difference between his *sanguinea* and *sinapium* is in color. *H. sanguinea* was from British waters.

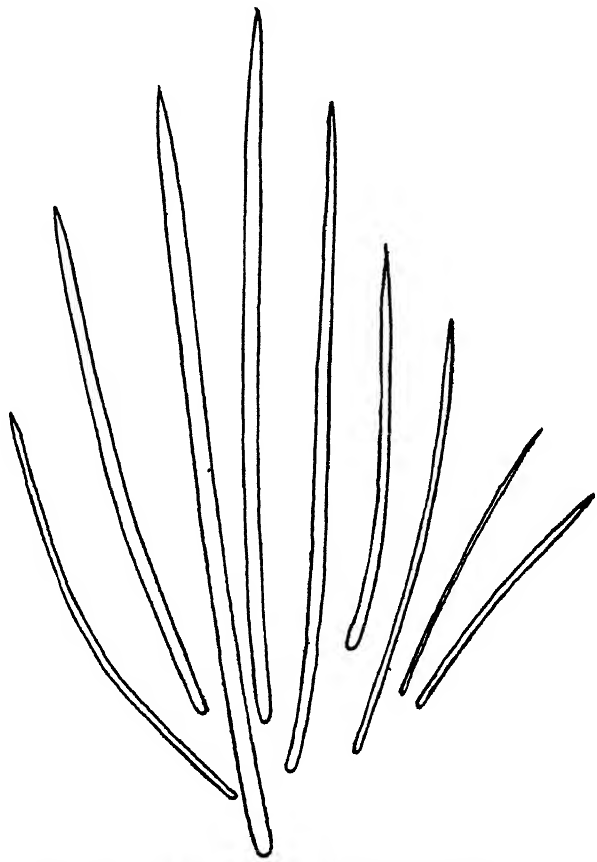

FIGURE 29.—*Hymeniacidon sinapium* de Laubenfels, ×300

In 1859, Lieberkühn described *Halichondria luxurians;* this was redescribed in 1862 (p. 76) by Oscar Schmidt as *Reniera luxurians*. Schmidt says that this is *Reniera variabilis* of Nardo, an utterly unrecognizable species, so devoid of description as to be properly a *nomen nudem*. I mention *luxurians* because, so far as Lieberkühn's and Schmidt's descriptions go, this may be the same as *sinapium;* but we do not know the spicule size, nor is the structure well described. *R. luxurians* is a Mediterranean species.

In 1862 (p. 1111), Bowerbank described *Hymeniacidon caruncula*, the type of this genus. It differs from *sinapium* only in having much smaller spicules. Bowerbank described them as 218μ, and the specimens I collected at Plymouth had then only about 120 to

140μ. Some authors synonymize *caruncula* with *sanguinea*, but there seem to be no British intergrades between the blood-red, long-spiculed form and the yellow or orange short-spiculed form; our Californian sponge might be considered such an intergrade, or rather a distinct species, since we have here none just like either *caruncula* or *sanguinea*. *H. caruncula* was from British waters.

In 1911 (page 13), Wilson described *Stylotella heliophila* from the Eastern United States (Beaufort, N. C.). This differs from *sinapium* only in having a slightly crisper consistency and more uniformly orange color. Possibly *sanguinea*, *luxurians*, *caruncula*, *heliophila*, *sinapium*, and perhaps even more species, put in at least five different genera, may be really synonymous; they are certainly very closely related.

HYMENIACIDON UNGODON, new species

Holotype.—U.S.N.M. No. 22061; B.M. No. 30.10.8.4.

Type locality.—The holotype was collected by me at Point Lobos, south of Carmel, Calif., intertidal, July 12, 1930. Otherwise I have seen this species several times in collections made by students. It is probably a moderately common sponge in central California.

Description.—Shape, encrusting. Size, 1 cm by 3 cm by 4 cm at least, probably often larger. Consistency, soft. Color in life, mahogany-brown ectosome over yellowish-drab endosome. Oscules, infrequent, oval, about 1 mm in long axis; they are closable by a membrane. Pores, inconspicuous, usually found closed. The surface is coarsely rugose.

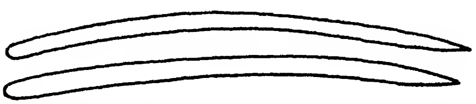

FIGURE 30.—*Hymeniacidon ungodon*, new species, ×300

Ectosomal specializations, fleshy, densely packed with spicules in confusion, not very easily detachable. Endosomal structure, fleshy, with spicules strewn mainly in utter confusion. In places there seem to be vague ascending tracts, but these may possibly be due merely to proximity of canals from which the spicules are excluded. This results in concentrations of spicules in the regions between the canals.

Spicules, styles 4μ by 180μ to 8μ by 200μ, with a few very much thinner that were probably immature forms (fig. 30).

Remarks.—Quite a few species of the genus *Hymeniacidon* have ectosome differently colored from the endosome, but the particular color scheme of *ungodon* seems characteristic and unique in the genus. The method of closure of oscules by a membrane stretching across instead of sphinctrate contraction is worthy of note. In at least some portions of the endosome of the present species were

numerous annulate filaments, the annulations being due to swellings caused by spheroidal optically refringent granules. These structures were about 3μ in diameter and of indefinite length. They may have been elongate archaeocytes, but the most probable assumption seems to be that they were (symbiont?) algae.

Genus PRIANOS J. E. Gray

PRIANOS PROBLEMATICUS de Laubenfels

Prianos problematicus DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21484; B.M. No. 29.8.22.16.

Type locality.—Two specimens were trawled on March 30, 1929, by Prof. T. Skogsberg, at a depth of 15 meters, south end of Monterey Bay, Calif.

Description.—Shape, massive to lobate. Size, 1 cm high, 2 cm in diameter. Consistency, stiff, slightly compressible. Color in life and when preserved, pale drab. Oscules, round, flush; diameter, about 2 mm. Pores, 200μ to 450μ in diameter. Surface, superficially smooth.

Ectosomal specialization, a dermal membrane; this is not readily detachable, is fleshy, and contains spicules strewn irregularly. Endosomal structure, "crumb-of-bread," with spicules in confusion.

Principal spicules, strongyles (fig. 31, *A*, *B*); size, 6μ by 135μ to 10μ by 140μ. Secondary spicules, oxeas (fig. 31 *D*, *E*); size, 2μ by 80μ to 2μ by 100μ; these might be regarded as microscleres.

FIGURE 31.—*Prianos problematicus* de Laubenfels: Typical spicules, ×300; *C* probably an immature *A*

Remarks.—The systematic position of those sponges having spicules principally strongyles needs some explanation. The first assignment of such was by O. Schmidt to his genus *Reniera* (1862, page 72), type species *R. aquaeductus*. Simultaneously he established *R. cratera*, which has a spiculation of strongyles only. Vosmaer in 1885 referred to this as genotype of *Reniera*, but this can not be, as Schmidt plainly stated in his original description that *aquaeductus* is the type. Among other Renieras with strongyles may be mentioned *R. amorpha* Schmidt (1864, p. 38), *R. hebes* Schmidt (1870, p. 40), and *R. crassa* Carter (1876, p. 312), which may be a *Strongylophora* (see below).

The first genus created for sponges characterized by strongyle spiculation was *Prianos* Gray (1867, p. 520) for Schmidt's *Reniera amorpha* (see above). This genus was regarded by Vosmaer (1885, p. 234) as not separable from *Reniera*, and it has therefore been subsequently ignored and forgotten. *Prianos amorphus* is not

renierid, however, but contains spicules in confusion; *Reniera* (*Haliclona*) is for sponges with oxeas in isodictyal reticulation. As a matter of fact there is a British sponge that answers rather closely to Schmidt's description of *amorpha*. Bowerbank (1874, p. 243) called it *Desmacidon columella*, and subsequent authors, led by Hanitsch (1894, p. 180) have called it *Stylotella columella*. *Stylotella* Lendenfeld (1888, p. 185), type species as fixed by Hallmann (1914, p. 348), *S. digitata* (which is Ridley's *Hymeniacidon agminata*), is suberitid. It must be said that the specimen of *columella* that I collected at Plymouth, in September, 1928, agreed even more closely with Schmidt's description of *amorpha* than did Bowerbank's original description. The species *columella* and *amorpha* may or may not be specifically identical, but they are clearly congeneric and not properly *Reniera*, *Desmacidon*, or *Stylotella*. *Prianos* may quite fitly be employed for them.

Other genera with strongyles as principal spicules include the following without microscleres:

Joyeuxia Topsent (1892, p. 93), type species *J. viridis*. In this the spicules are almost all dermal, the endosome being nearly devoid of skeleton. Some of the spicules are oxeas. See the genus *Phloedictyon* for comparisons.

Batzella Topsent (1893, p. xxxiv), type species *B. inops*, like the above has very few spicules at all. It had mycalid embryos. Some of its spicules were styles. See *Inflatella* for comparisons.

Liosina Thiele (1899, p. 16), type species *L. paradoxa*. This may be a synonym of *Prianos*.

Petrosia Vosmaer (1885, p. 338), type species *P. dura*, is stony hard. It is interesting to compare consistencies here, as both *Prianos amorphus* and *P. columellus* are very soft, while *P. problematicus* is intermediate, just moderately stiff and firm.

Protoschmidtia Czerniavsky (1879, p. 380), type species *P. simplex*. This genus is inadequately known; is referred to as halichondroid with hispid dermis, "surface set over with tubes," spicules strongyles.

The following genera with microscleres have strongyles as principal spicules. In view of the well-known fact that microscleres may be lacking for unknown reasons, all species without them may be but derivatives by reduction, but often it is impossible to ascertain the source. *Prianos* may therefore really be congeneric with some one of the following:

Barbozia Dendy (1922, p. 131), type species *B. primitiva*. The microscleres are anisochelas and discorhabds; the sponge is papillate.

Phlyctaenopora Topsent (1904, p. 198), type species *P. bitorquis*. The microscleres are anisochelas and sigmas; this also is papillate.

Guitarra Carter (1874, p. 210), type species *G. fimbriata.* The microscleres are very peculiar and distinctive, and therefore one can hardly believe that this is closely related to the others here mentioned. This is very provocative of thought in view of the impossibility of sharply separating it were it to lose its microscleres as individuals probably do.

Dyscliona Kirkpatrick (1900, p. 352), type species *D. davidi*, a boring sponge with very peculiar microscleres; this is another reason for doubting that similarity of megascleres indicates close relationship in absence of other bonds of unity.

Strongylacidon von Lendenfeld (1897, p. 110), type species *S. sansibarense.* This has anisochelas as microscleres.

Strongylamma Hallmann (1917, p. 643), type species *S. carteri.* This had two sizes of spiny microrhabds and contained much sand.

Strongylophora Dendy (1905, p. 141), type species *S. durissima.* This had smooth microrhabds, often bent, and was stony hard.

Although far from certain, it is quite possible that one of or all these last three are congeneric with *Prianos.* The structures are such that all may be considered much more closely related to *Prianos* than that genus or any of them is to *Reniera.* The same should be said of *Petrosia* and *Liosina.* It should be kept in mind that, of all these, *Prianos* (1867) has the priority.

Order POECILOSCLERINA Topsent

Family DESMACIDONIDAE Gray

Genus BIEMNA J. E. Gray

BIEMNA RHADIA de Laubenfels

Biemna rhadia DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21507; B.M. No. 29.9.30.17.

Type locality.—The one specimen was collected by E. F. Ricketts in 1925 from Monterey Bay, Calif., depth 700 meters; it was lodged in a recess of a macerated dictyonine hexactinellid sponge skeleton.

Description.—Shape, amorphous. Size, 7 mm high, 12 mm in diameter. Consistency, stiffly fragile. Color dry, drab. Oscules and pores, not evident, because of cavernous structure. Surface, superficially very cavernous.

Ectosomal specialization, a dermal membrane about 15μ thick; detachable, fleshy, containing microscleres but not megascleres. Endosomal structure, "crumb-of-bread," with stiff, ascending, branching tracts. Principal, or ascending, tracts about 400μ in diameter, cored by densely packed styles. There seems to be little or no spongin present.

Principal spicules, styles (fig. 32, *A*); size, about 20μ by 1,300μ. First microscleres, sigmas (fig. 32, *B*); size, about 13μ by 300μ. Second microscleres, sigmas (fig. 32, *C*); size, about 4μ by 90μ. Third microscleres, sigmas (fig. 32, *D*); size, about 1μ by 25μ. Fourth microscleres, smooth raphides (not figured); size, 1μ by 120μ to 2μ by 210μ; these are usually packed in short fascicular tracts about 50μ in diameter.

Remarks.—The nearest relative of this form seems to be *B.* (*Desmacella*) *fortis* Topsent, 1897, from the East Indies and Red Sea, which differs in not having the larger size range of sigmas. *Biemna megalosigma* Hentschel, 1912, has the large size range of sigmas as well as the medium and smaller, but has peculiar siliceous spheres

FIGURE 32.—*Biemna rhadia* de Laubenfels, ×300. *A*, terminations of the styles, showing their thickness but not their length; *B–D*, range in size and shape of the sigmas

not in the California species, has megascleres but two-thirds as large, and raphides also much smaller. It may well be that upon making thorough revision of the genus one would find these and numerous other species of *Biemna* worthy of reduction to synonymy, but this step does not seem called for at present.

Similar species of this genus are reported from practically all parts of the world.

Genus DESMACELLA Schmidt

DESMACELLA VAGABUNDA Schmidt

Desmacella vagabunda O. SCHMIDT, 1870, p. 53.

Holotype.—Location unknown; described from the West Indies.

Material examined.—One of several specimens (U.S.N.M. No. 21508; B.M. No. 29.8.22.61) growing in the interstices of a macerated dictyonine hexactinellid sponge skeleton collected by E. F. Ricketts, May 9, 1929, in Monterey Bay, depth 700 meters.

Description.—Shape, amorphous. Size, undeterminable, because of concealment in hexactinellid skeleton. Consistency, fragile. Color in life and when dry, drab. Oscules, flush with the cloacal surface of the hexactinellid, each almost filling the cavity left by one of the hexact's oscules. Pores, not evident. Surface, superficially smooth.

Ectosomal specialization, a very thin, detachable, fleshy dermis. It contains a few scattered microscleres. Endosomal structure, short plumose columns or simple brushes of tylostyles, points toward the surface, accompanied by a surprisingly small quantity of protoplasmic material.

Principal spicules, tylostyles (fig. 33, *A*, *B*); size, about 15μ by 600μ. Microscleres, sigmas (fig. 33, *D*); length, about 60μ.

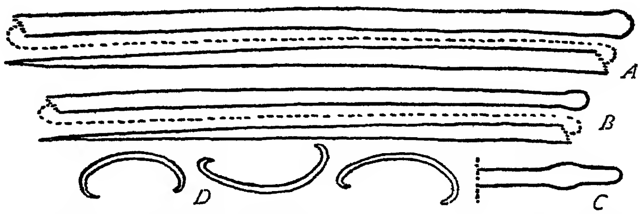

FIGURE 33.—*Desmacella vagabunda* Schmidt, ×300. *C*, an unusual modification of the head of the megasclere

Remarks.—Schmidt's *Desmacella vagabunda* was very briefly described. The sponge now under discussion offers so little material for examination that it can only be said to be imperfectly known. It seems better to identify it with *vagabunda* than to establish a new species for it, because all that we know of it agrees sufficiently well with what we know of *vagabunda* to make it probable that they are conspecific.

ZYGHERPE, new genus

This genus is of the family Desmacidonidae and is close to *Desmacella*, from which it differs chiefly by the addition of the diancistra to the other skeletal elements. Genotype: *Zygherpe hyaloderma*, new species.

ZYGHERPE HYALODERMA, new species

Holotype.—U.S.N.M. No. 22060; B.M. No. 30.10.8.3.

Type locality.—The holotype was collected by me on July 13, 1930, at Point Lobos, intertidal, south of Carmel, Calif. The encrustation carpeted a rock on the floor of a grotto, which was inaccessible except at very low tide.

Description.—Shape, encrusting. Size, 1 to 3 mm thick, spreading laterally indefinitely. Consistency, soft, fleshy. Color in life, pale ochraceous-yellow. Surface, lipostomous and smooth. A conspicuous feature of the living and preserved sponge is the very evident system of comparatively coarse canals meandering about beneath the transparent dermis, branching and reuniting. It is to be presumed that contractile minute exhalent apertures riddled the covering to these canals during life, and that similar inhalent openings were dispersed over the rest of the surface.

Ectosomal specialization, fleshy, abundantly packed with microscleres. Endosomal structure, basically fleshy with abundant microscleres and scattered ascending plumose tracts of tylostyles, points upward and outward. These make inconspicuous terminal brushes at the places where the tracts reach the surface. These tracts are approximately 50μ apart; they branch and anastomose but rarely.

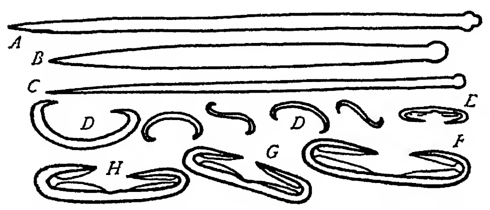

FIGURE 34.—*Zygherpe hyaloderma*, new species: *A–E*, ×300; *F–H*, ×600

Megascleres, tylostyles about 5μ by 150μ. First microscleres, sigmas 25μ to 50μ in length of chord. Second microscleres, diancistras, the points nearly meeting.

Remarks.—The diancistra is a very curious and characteristic spicule. Possession thereof can hardly be used, however, as an indication of close phylogenetic relationship, for the three previously described genera having this microsclere differ fully as much from each other as from *Zygherpe*. In addition to the diancistra, each possesses other spicules as follows: *Hamacantha*, styles to oxea and toxas with rhaphides; *Vomerula*, styles and toxas with chelas; *Pozziella*, exotyles, peculiar styles and very peculiar sigmas. As mentioned above, *Zygherpe* seems much more closely related to *Desmacella* than to any other genus.

Genus MYCALE J. E. Gray

MYCALE BELLABELLENSIS (Lambe)

Esperella bellabellensis LAMBE, 1905, p. 14.
Esperella fisheri DE LAUBENFELS 1926, p. 570.

Holotype.—In the Museum of the Geological Survey, Ottawa, Canada.

Type locality.—The west coast of Canada.

Material examined.—There is a magnificent specimen of this sponge at Hopkins Marine Station (Pacific Grove) a good 4 feet

in diameter; it was taken at a depth of about 50 meters, date not recorded, in Monterey Bay, entangled on a fisherman's line. It is represented by U.S.N.M. No. 21440 and B.M. No. 28.11.6.4. E. F. Ricketts also collected a specimen from Monterey Bay, depth 800 meters, date not recorded. It is represented by U.S.N.M. No. 21470 and B.M. No. 29.8.22.12.

Description.—Shape, stipitate, older specimens funnel-shaped. Size, up to at least 100 cm high, 122 cm in diameter. Consistency, between spongy and fragile. Color in life and when preserved, drab. Oscules, irregular in size and shape, not definitely delineated, especially in the larger specimens. Pores, represented by even more irregular openings. Surface, superficially very rough with depressions sometimes 5 cm deep.

Ectosomal specialization, a dermal membrane. It is fleshy, very thin, and contains microscleres and a very few megascleres. Endo-

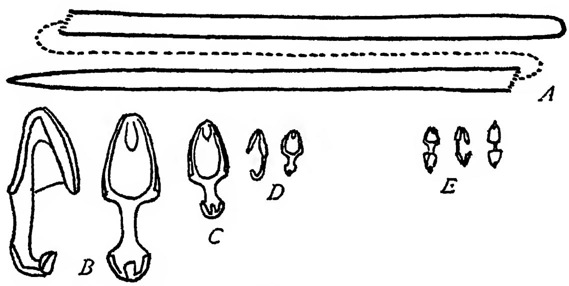

FIGURE 35.—*Mycale bellabellensis* (Lambe), ×300. Spicules of Californian specimen (U.S.N.M. No. 21470 and B.M. No. 29.8.22.12). Microscleres *B*, *D*, and *E* in front and side views

somal structure cavernous, traversed by spicular tracts which branch but rarely anastomose. Principal, or ascending, fibers up to 1 mm in diameter, cored by abundant styles.

Principal spicules, styles (fig. 35, *A*); size, 12μ by 432μ to 13μ by 491μ. First microscleres, palmate anisochelas (fig. 35, *B*); length, 70μ to 90μ, often in rosettes. Second microscleres, palmate anisochelas (fig. 35, *C*); length, 32μ to 36μ. Third microscleres, palmate anisochelas (fig. 35, *D*); length, 22μ to 27μ. Fourth microscleres, palmate isochelas (fig. 35, *E*); length, about 22μ.

Remarks.—The large funnel-shaped Californian specimen (U. S. N. M. No. 21440 and B. M. No. 28.11.6.4) agrees with Lambe's rather closely; but Lambe recorded small sigmas (19μ to 30μ); whereas long search has so far yielded only one doubtfully proper sigma in the California specimen, and Lambe's was much smaller. I have also another specimen still smaller, possibly a juvenile, collected at a depth of about 800 meters in Monterey Bay by E. F. Ricketts. It is

only 10 cm high and 6 cm in diameter and is stipitate but not funnel-shaped, being instead rather lobate. It agrees with the funnel-shaped specimens except that it seems to have no sigmas at all, but instead a few toxas about 4μ by 400μ. It has also numerous palmate isochelas about 22μ long, which may be foreign, yet several species of *Mycale* are recorded with such microscleres in addition to the typical amoschelas. That they and the toxas may not be proper is indicated by the finding of a few such obviously foreign spicules as some plesiasters, tylotes, and short renierid oxeas, but the isochelas are quite numerous. The surface of this specimen is also notably different, in having a distinct oscule 4 mm in diameter and definite contractile dermal pores, one to three to each square millimeter of surface.

MYCALE MACGINITIEI[8] **de Laubenfels**

Mycale macginitiei DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21471; B.M. No. 29.8.22.3.

Type locality—Elkhorn Slough (intertidal) on the east shore of Monterey Bay, Calif., collected by Prof. G. E. MacGinitie, March 1, 1929. Several years ago a pile of rocks was dumped at one place in this area of tidal mud flats, and this sponge and a *Halisarca* have now appeared encrusting them.

Description.—Shape, encrusting. Size, less than 1 cm thick. Patches mostly less than 6 cm in diameter. Consistency, mediocre. Color in life and when preserved, drab. Oscules, not evident. Pores, about 30μ in diameter and about 70μ from center to center. Surface, superficially smooth.

Ectosomal specialization, a dermal membrane; very thin, detachable, fleshy, contains spicules in confusion. Endosomal structure, "crumb-of-bread," with fibers; little or no reticulation is present. Principal, or ascending, fibers 70μ to 100μ in diameter, cored by many spicules, but with little spongin. Below the surface they expand in brushes, the most divergent spicules being actually within the dermis.

Principal spicules, subtylostyles (fig. 36, *A*); size, 9μ by 250μ to 10μ by 280μ. First microscleres, palmate anisochelas (fig. 36, *B*); length, 30μ to 36μ, often in rosettes. Second microscleres, palmate anisochelas (fig. 36, *C*); length, about 13μ. Third microscleres, toxas (fig. 36, *D*); length, 45μ to 75μ. Fourth microscleres, sigmas (fig. 36, *E*); length, 60μ to 75μ. The microscleres are distributed generally throughout the flesh. The toxas are very rare.

Remarks.—The nearest relatives of this species seem to be the *Mycale macilenta* Bowerbank, 1866, from Great Britain (recorded by Hentschel in 1912 from Australia), and *Mycale aegagropila* Bower-

[8] Named for Prof. G. E. MacGinitie, of Stanford University, who discovered this sponge.

bank, 1866, from Great Britain. *M. macilenta* differs in having enormous toxas. *M. aegagropila* differs in that its megascleres, sigmas, and toxas are 15 to 50 per cent larger than in *macginitiei.* Were one to synonymize those two, *macginitiei* would fall as a third synonym. As long as the two mentioned are retained as separate species, *macginitiei* should also stand. Bowerbank put *macilenta* in *Hymeniacidon, aegagropila* in *Desmacidon;* and Gray, 1867, made a genus *Aegagrophila* for the latter. Some recent authors, especially Wilson, 1925, synonymize *macilenta* with *aegagropila.* On the other hand, Hentschel, 1913, gives data that seem to me adequate demonstration of sufficient difference to warrant retaining most of the present species

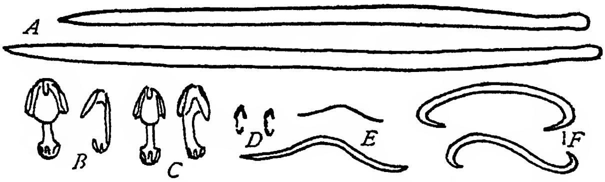

FIGURE 36.—*Mycale macginitiei* de Laubenfels, ×300

of *Mycale* for our convenience in discussing them, if for no other reason. The differences between these others and *macginitiei,* though not great, when taken in conjunction with the geographical locations, make it seem advisable to retain it and them as distinct species.

Genus PARESPERELLA Dendy

PARESPERELLA PSILA de Laubenfels

Paresperella psila DE LAUBENFELS, 1930, p. 26.

Holotype.—U.S.N.M. No. 21478; B. M. No. 29.8.22.38.

Type locality.—Monterey Bay, Calif., trawled by Prof. T. Skogsberg, on March 30, 1929, depth 15 meters. I found one other specimen, beachworn and macerated, in the wrack at Hopkins Marine Station, March 20, 1929. That the species may be moderately common is indicated by the frequency with which one notes the distinctive serrated sigmas in sponges having obviously foreign spicules. There is this much evidence to indicate its occurrence also in southern California.

Description.—Shape, amorphous to massive. Size, 3 cm high, 5 cm in diameter. Consistency, between spongy and fragile. Color in life and when preserved, pale drab. Oscules, not evident. Pores, 50μ to 200μ in diameter; abundant. Surface, superficially smooth.

Ectosomal specialization, a dermal membrane, about 20μ thick. It is fleshy, detachable, and contains abundant tangentially placed spicules of all the sorts characteristic of the species. Endosomal structure, "crumb-of-bread," with very evident threadlike fibers.

Very few of the large sigmas are found in the endosome. Ascending fibers, 100μ to 300μ in diameter, cored by the styles.

Principal spicules, subtylostyles (fig. 37, *A*); size, about 10μ by 410μ. First microscleres, giant serrated sigmas (fig. 37, *B*); length, about 210μ to 265μ. Second microscleres, sigmas (fig. 37, *C*); length, about 40μ to 45μ. Third microscleres, palmate anisochelas (fig. 37, *D*); often in rosettes; length, 32μ to 38μ. Fourth microscleres, palmate anisochelas (fig. 37, *E*); length, 16μ to 17μ.

Remarks.—Hentschel (1913) in his summary of the genus *Mycale* includes *Paresperella* (Dendy, 1905, p. 162, type species *P. serratohamata*), but I hesitate to drop Dendy's genus without further study. The size of the sigmas can not be used, it is true, for all grades occur intermediate between the giant ones of *Paresperella* and the typical small ones of *Mycale*, but the serration may be a distinctive difference; and for the present, I propose to use it as

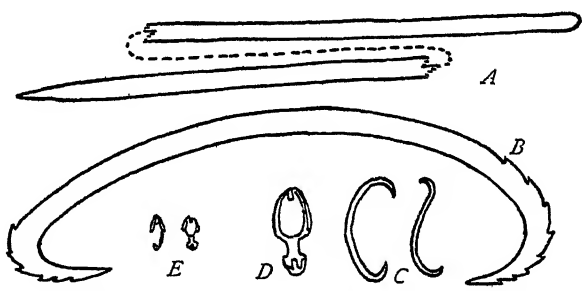

FIGURE 37.—*Paresperella psila* de Laubenfels, ×300

distinctive of *Paresperella*, retaining this genus. The only sponge having spicule measurements at all close to those of *psila* is *Mycale fascifibula* Topsent, 1904, from the Azores, but its megascleres are polytylote, it has raphides, and its large sigmas not serrated. Lambe (1894, p. 130) records a sponge from Vancouver Island, British Columbia, as *Esperella serratohamata* Carter, but it is quite distinct from *psila* and is not certainly correctly identified with Carter's species. As compared to *psila*, it has much smaller (335μ) megascleres, smaller (157μ) macrosigmas, lacks the smaller anisochelas, and has toxas, which *psila* lacks.

Genus ESPERIOPSIS Carter

ESPERIOPSIS ORIGINALIS de Laubenfels

Esperiopsis originalis DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21441; B.M. No. 29.8.22.54.

Type locality.—Pacific Grove, Calif., July 2, 1926, intertidal, collected by me. The species is common in this vicinity. At first I

confused it with *Ophlitaspongia pennata* (which see); but in addition to the differences between the sponges there is also a difference in the habitat, the two overlapping little if any. As noted elsewhere, *pennata* occurs nearer high-tide mark than any other sponge of which I know, usually on the sides of bowlders beneath pendant seaweed. *E. originalis* occurs very near low-tide mark and also below it, usually underneath stones. It also grows loose and unattached or on coralline algae. It is moderately common in central California, and on March 14, 1926, I found several small patches of this species encrusting rocks intertidally at Laguna Beach.

Description.—Shape, massive. Size, 2 by 3 by 7 cm. Consistency, stiff, slightly compressible. Color in life, light brownish red; preserved, pale drab. Oscules, round, not raised; diameter, up to 2 cm. The oscules are largest and most frequent where the sponge is thickest. One small, undamaged specimen brought into the laboratory, July 2, 1926, exhibited strong oscular currents, tall transparent protoplasmic "chimneys" being thrown up above the surface by the force of the stream. They were contractile, at times reducing the size of the actual opening to far less than that of the canal or cloaca below, without shortening much if at all. In this sponge the cloacal tubes were about 300μ in diameter, and the chimneys raised also about 300μ above the surface. Pores, not evident; clearly they must be exceedingly minute. Surface, superficially very smooth.

Ectosomal specialization, a dermal membrane only 2μ to 5μ thick; detachable, fleshy, contains probably but one cell layer and seemingly no spicules. Endosomal structure, a very regular reticulation of strong fibers perpendicular to the surface, containing a little spongin and many rows of styles, points almost always toward the surface. The connectives are merely single spicules, however, but placed almost as symmetrically as the rungs of a ladder. Histological details: The subspherical flagellate chambers are about 30μ in diameter. Ascending fibers, 25μ to 35μ in diameter and about 150μ apart. Accessory, or transverse, fibers, single spicules only.

Principal spicules, subtylostyles (fig. 38, *A*, *B*); size, 12μ by 150μ to 13μ by 155μ. Microscleres, palmate isochelas (fig. 38, *C*, *D*); length, 13μ to 16μ.

Remarks.—Comparison between this species and *Ophlitaspongia pennata* is interesting. Neither is typical of the genus in which it is now placed, and either could be shifted over to the other genus without violence. The two species are easily separated when the microscleres are to be found, however, as the one has only chelas where the other has toxas. *E. originalis* has also much smaller magascleres. The colors are not quite the same, *originalis* having a rather brownish tinge where *pennata* is clear bright red.

This differs from typical *Esperiopsis* in lacking sigmas. The very symmetrical ladder structure is a bit unusual, though isodictyal structure and fibrous structure are common in this genus. The dermis is typical. The closest relative seems to be *Esperiopsis glaber* Brøndsted (1924, p. 141) from New Zealand, which has exactly the same architecture, but longer styles (up to 10μ by 370μ), and has three sizes of sigmas.

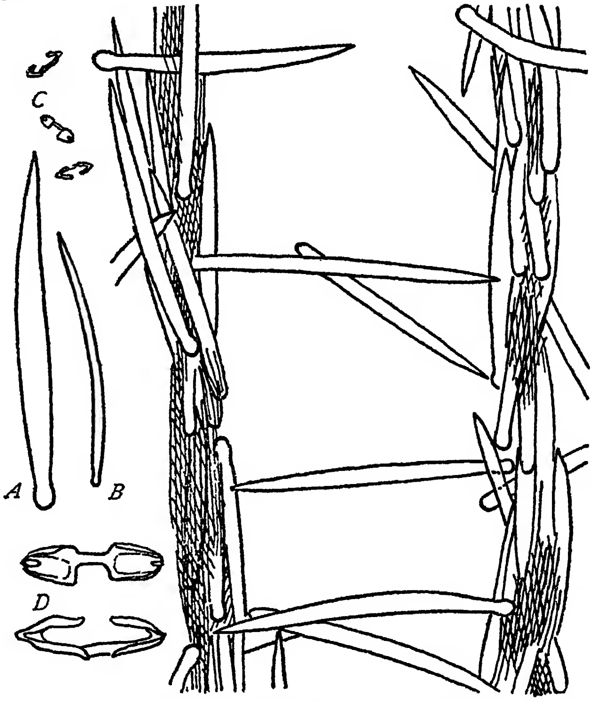

FIGURE 38.—*Esperiopsis originalis* de Laubenfels: Portion of the skeleton. *A*, Maximum size of the megasclere; *B*, small size of the megasclere, probably immature; *C*, *D*, microscleres. *D*, ×1,333; others, ×300

Genus WILSA [4] de Laubenfels

Wilsa may be defined as of the subfamily Mycalinae, for sponges with smooth monaxon megascleres, palmate isochelas and forceps, typically with macrosigmas as well as sigmas of the more usual size. Genotype: *Wilsa hymena*.

WILSA HYMENA de Laubenfels

Wilsa hymena DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21515; B.M. No. 29.8.22.62.

Type locality.—Monterey Bay, Calif., May 9, 1929, depth 700 meters, collected by E. F. Ricketts. The one specimen was on the

[4] Named for Prof. H. V. Wilson, of the University of North Carolina.

macerated skeleton of a dictyonine hexactinellid sponge, and was in intimate contact along one edge with *Lissodendoryx kyma* (which see).

Description.—Shape, encrusting. Size, 5 by 18 mm in area; the depth can not be measured, as the sponge penetrated into the macerated dictyonine skeleton on which it was growing. Consistency, fragile. Color in life and when dry, pale drab. Oscules and pores, not evident. Surface, superficially smooth.

Ectosomal specialization, a dermal membrane; fleshy, detachable, about 30μ to 70μ thick, containing abundant macrosigmas. Endosomal structure, the endosome is so blended with the hexactinellid skeleton that its proper structure can not be ascertained.

Principal spicules, smooth styles (fig. 39, *A*); size, 10μ by 330μ to 15μ by 600μ. First microscleres, palmate isochelas (fig. 39, *D*); length, 17μ to 20μ. Second microscleres, giant sigmas or macrosigmas

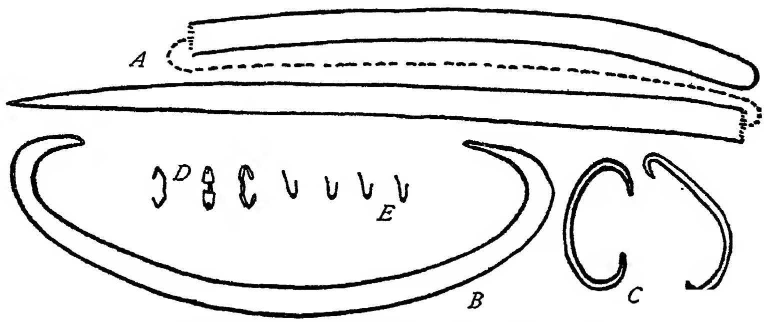

FIGURE 39.—*Wilsa hymena* de Laubenfels, ×300

(fig. 39, *B*); length, about 250μ. Third microscleres, sigmas (fig. 39, *C*); length, 55μ to 75μ. Fourth microscleres, forceps (fig. 39, *E*); length, 10μ to 12μ.

Remarks.—Practically all that can be obtained for this interesting sponge is of the nature of ectosome. It contains some tornotes and a very few arcuate chelas, obviously from its neighbor *L. kyma.* It is packed with the macrosigmas, has but few of the microsigmas, moderate quantities of the palmate isochelas, and rather numerous forceps. These latter appear smooth with less resolving power than 0.95 numerical aperture, and even with the utmost care only the very faintest traces of spination can be discovered, but very small spines are certainly present. The deeper portions contain a few scattered styles as mentioned, but no scheme of their arrangement could be discovered.

The closest relative of *hymena* is clearly Lundbeck's *Esperiopsis forcipula* (1905, p. 17), which should also be placed in the genus *Wilsa.* Its styles are 540μ to 680μ; its macrosigmas only 83μ; its

microsigmas only 30μ; its chelas are much larger (38μ to 50μ) and more nearly arcuate than those of *hymena*; its forceps are larger (17μ) and much more clearly spined.

Some authors (see Topsent, 1928) would regard the presence of forceps as of little taxonomic value. Such conclusions as this are probably correct, but until an extensive revision of the phylum is carried out, consistently eliminating the very numerous genera founded on such bases, it is only consistent to continue using such criteria. Topsent himself continues to found many new genera based upon peculiarities of microscleres. I think he is quite justified in this on the grounds of expediency, and I follow this action of his rather than his suggestion that would lead to making *Esperiopsis* a genus of a size so large as to be unwieldy.

Family COELOSPHAERIDAE Hentschel

Genus ASTYLINIFER Topsent

ASTYLINIFER ARNDTI[5] de Laubenfels

Astylinifer (?) *arndti* DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21435; B.M. No. 29.8.22.4.

Type locality.—Point Pinos, near Pacific Grove, Calif., intertidal, July 8, 1929. Several other specimens were secured the same day in the same general locality, where the species seemed definitely to be a new arrival, frequent earlier searches over a period of some five years having failed to yield this sort of sponge.

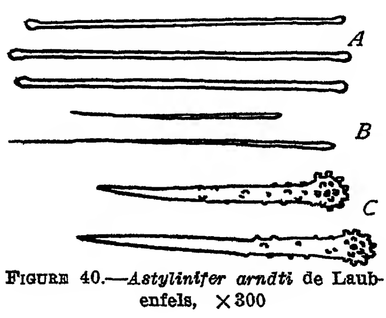

FIGURE 40.—*Astylinifer arndti* de Laubenfels, ×300

Description.—Shape, encrusting. Size, 0.4 to 1.3 mm thick; several centimeters in diameter. Consistency, mediocre. Color in life, some specimens ocher-yellow, others with purple areas, and some halfway between the two colors present and appearing brown. Preserved specimens are drab. Oscules and pores, not evident. Surface, superficially smooth.

Ectosomal specialization not discernible. Endosomal structure, predominantly protoplasmic with scattered fascicular bundles of tylotes, often, but not always perpendicular to the surface. At the very base are a few acanthotylostyles perpendicular to the substratum.

Principal spicules, tylotes (fig. 40, *A*), 3μ by 140μ to 4μ by 145μ. Echinating spicules, acanthotylostyles (fig. 40, *C*), 8μ by 110μ to 9μ

[5] Named for Prof. Walther Arndt, of the University of Berlin.

by 130μ. Microscleres, rhaphides (fig. 40, *B*); size ½μ by 95μ to 1μ by 140μ.

Remarks.—The other member of this genus, *A. planus* Topsent (1927, p. 9), has tylotes of double the measurements of those of *arndti* and a few toxas in addition to diactinal rhaphides. As a matter of fact *arndti* is very close to the genus *Hymedesmia* from which it may be derived. It is interesting to compare it to *Hymenamphiastra cyanocrypta* from the same general locality. *A. arndti* has much smaller acanthotylostyles, which further play a very insignificant part in the sponge as a whole, the bulk of it having only tylotes. In *cyanocrypta* the tylotes are more distinctively just dermal spicules, and, of course, there are the very peculiar microscleres. A further noteworthy difference is in the shape of the ends of the tylotes, which in *arndti* are ball-like, nearly spherical; in *cyanocrypta* they are elongate-oval with hastate terminations.

Family MYXILLIDAE Topsent

Genus LISSODENDORYX Topsent

LISSODENDORYX KYMA de Laubenfels

Lissodendoryx kyma DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21511; B.M. No. 29.8.22.60.

Type locality.—The one specimen was growing on the macerated dictyonine skeleton collected by E. F. Ricketts, on May 9, 1929, in Monterey Bay, Calif., depth 700 meters.

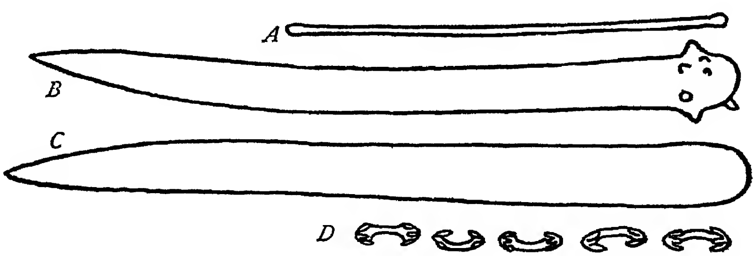

FIGURE 41.—*Lissodendoryx kyma* de Laubenfels, ×300

Description.—Shape, encrusting. Size, 5 mm thick, 28 mm in diameter. Consistency, fragile and friable. Color in life and when dry, pale drab. Oscules and pores, not evident. Surface, superficially wavy, with the troughs about 2 mm deep.

Ectosomal specialization, an indefinite sort of dermal membrane, not detachable; it is packed with tangentially placed tornotes. Endosomal structure, "crumb-of-bread," with large styles in confusion.

Principal spicules, smooth styles (fig. 41, *C*); size, 25μ by 350μ. Secondary spicules, styles with spiny heads (fig. 41, *B*); size, 20μ by 340μ. Ectosomal spicules, tornotes (fig. 41, *A*); size, 5μ by 205μ. Microscleres, arcuate chelas (fig. 41, *D*); length, 25μ to 30μ.

Remarks.—This species is peculiar for having only the one sort of microsclere, and the disproportion between the ectosomal and endosomal spicules is not common.

Similar species of this genus are reported from all parts of the world.

LISSODENDORYX NOXIOSA de Laubenfels

Lissodendoryx noxiosa DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21467; B. M. No. 29.8.22.14.

Type locality.—Pacific Grove, Calif., intertidal, July, 1925, collected by me. This species is very abundant in the Monterey region, growing in a variety of situations in the intertidal zone, but most frequently in crevices or under rocks.

Description.—Shape, amorphous. Size, at least 10 cm high and 15 cm in diameter. Consistency, spongy. Color in life, yellow; preserved much paler, nearly colorless. Oscules, there may or may not be present surface openings or depressions of very irregular size and shape, which may or may not be oscules or pores or neither or both. Pores, see remarks above. Surface, primarily smooth but with more or less abundant irregularities in the form of both lumps and pits.

Ectosomal specialization, a dermal membrane, about 30μ thick; so contractile that it is difficult to study the afferent and efferent openings. It is in places easily detachable, but upon removal it contracts so vigorously as to preclude satisfactory study. Elsewhere it is very difficult to remove it. Apparently it contains few megascleres, the dermal spicules being employed to support it. After its removal the interstices of the endosomal reticulation are exposed with here and there irregular larger apertures. Endosomal structure, "crumb-of-bread," with a dense isodictyal reticulation of the styles; meshes usually triangular. The styles are often side by side, so placed as to outline chambers with walls having some resemblance to those of old-fashioned log cabins.

Principal spicules, styles (fig. 42, *B*, *C*); size, 10μ by 180μ to 12μ by 200μ. These styles almost always have about two to four rather large spines; occasionally they have as many as six or eight, and also a few are entirely smooth. The spines are rather more often to be noted on the heads than on the shafts. Very thin forms of both sorts of megascleres are met with, probably immature stages (fig. 41, *D*). Ectosomal spicules, tylotes (fig. 42, *A*); size, 4μ by 180μ

to 5μ by 200μ. First microscleres, arcuate chelas (fig. 42, *F*); length, 28μ to 33μ. Second microscleres, contort sigmas (fig. 42, *E*); length, 32μ to 40μ.

Remarks.—Many species of *Lissodendoryx* have been described as of *Myxilla*, and many differ from one another but slightly. Two Myxillas, properly to be transferred to *Lissodendoryx*, described by Lambe from the west coast of Canada, particularly merit comparison to *noxiosa*. The first is *lacunosa* (1892, p. 70), which differs from *noxiosa* in having hastate dermal spicules twice the thickness of those in the California species; it has styles very similar but with practically no spination, somewhat larger chelas, and smaller sigmas. The second is *firma* (1894, p. 122), which has dermal spicules shaped like those of *noxiosa*, but twice as thick, and styles about twice as large (up to 19μ by 366μ), and with no spines at all. Its chelas and sigmas are each much larger than in *noxiosa*, but quite noteworthy for their similarity in shape.

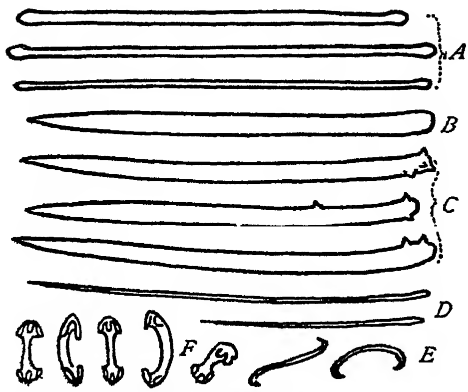

FIGURE 42.—*Lissodendoryx noxiosa* de Laubenfels, ×300. *F*, row of chelas, one at right nearly in end view

The styles of *noxiosa* are peculiar in having a few large spines, there being usually either smooth styles, or styles with many small spines, or many large ones. The most striking characteristic, however, is the strong, offensive odor of *noxiosa*. I am familiar with one other *Lissodendoryx* in the living condition (a West Indian form); that has a pungent odor, seemingly the same. In view of the supposed close relationship of *Lissodendoryx* with *Myxilla*, it is interesting to note that none of the Myxillas I have known in the living state had this odor. The odor may not be proper, however, as in 1929 I found two specimens of this species that lacked it.

LISSODENDORYX REX de Laubenfels

Lissodendoryx rex DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21512; B.M. No. 29.8.22.63.

Type locality.—This sponge was growing on the macerated skeleton of a dictyonine sponge collected in Monterey Bay, Calif., depth 700 meters, by E. F. Ricketts, on May 9, 1929.

Description.—Shape, massive. Size, 2 cm high, 3 cm in diameter. Consistency, fragile. Color in life and when dry, drab. Oscules, not evident. The exhalent openings presumably were toward the

concavity of the macerated hexactinellid on which this species grew, and therefore impossible to study. The bulk of the sponge was on the outer (convex) part of the hexact, but it ramified extensively into the dictyonine framework. Pores, not evident. Surface, superficially smooth.

Ectosomal specialization, a dermal membrane; very thin, detachable, fleshy. The dermis contains many of the sigmas, and a few scattered tangential tornotes, and is held up and away from the endosome by numerous fascicular bundles of the tornotes, perpendicular to the surface. The *Lissodendoryx* with which I am familiar in the West Indian region has just such an ectosomal structure. Endosomal structure, "crumb-of-bread," with scattered styles, most of which have their points toward the surface.

Principal spicules, styles (fig. 43, *B*); size, about 16μ by 570μ. Ectosomal spicules, tylotes (fig. 43, *A*); size, about 7μ by 280μ. Microscleres, sigmas (fig. 43, *C*); length, 50μ to 55μ.

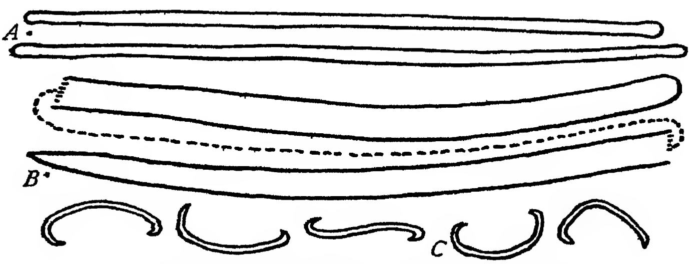

FIGURE 43.—*Lissodendoryx rex* de Laubenfels, ×300

Remarks.—Generic allocation of this sponge is very difficult, even for a sponge. The ectosome is typically *Lissodendoryx* and so are the sigmas, but the complete absence of chelas makes one doubt that this genus is the proper one to use. Smooth styles in the endosome are also characteristic of *Lissodendoryx*, but not styles so much larger than the ectosomal spicules, and the structure is radically different. *Lissodendoryx* should have monaxons in compact and nearly isodictyal reticulation; this sponge has the mycalid structure of many Biemnas. *Biemna* has similar spiculation, moreover, except for the special dermal spicules, so this could be described as a *Biemna* with the ectosome of a *Lissodendoryx*. One might erect a new genus, but in view of the scarcity of specimens on hand I regard such action as not at present called for.

Lundbeck (1905) would make the distinction between *Myxilla* and *Lissodendoryx* that the former has anchorate chelas, the latter arcuate or palmate. Where the chelas occur this is doubtless the best line of demarcation. In this aberrant form lacking the chelas, however, *Lissodendoryx* is chosen because, as Lundbeck notes, it usually has

smooth principal spicules as against *Myxilla*'s usually spiny principal spicules. Topsent separated *Lissodendoryx* originally on just this difference.

Genus MYXILLA O. Schmidt

MYXILLA AGENNES de Laubenfels

Myxilla agennes DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21415; B.M. No. 29.9.30.14.

Type locality.—The one specimen was collected February 16, 1924, by the University of Southern California at Point Fermin near San Pedro, Calif., intertidal.

Description.—Shape, amorphous. Size, 25 mm high, 30 mm in diameter. Consistency, mediocre. Color in alcohol, drab. Oscules and pores, not evident. Surface, superficially very lumpy.

Ectosomal specialization, a dermal membrane; this is 20μ to 60μ thick, not readily detachable, fleshy, and contains almost no spicules at all, but those present are tornotes. Endosomal structure, "crumb-of-bread," with very numerous spicules, often in confusion, but occasionally in vague isodictyal reticulation, and again sometimes in ascending plumose columns ending in surface protuberances.

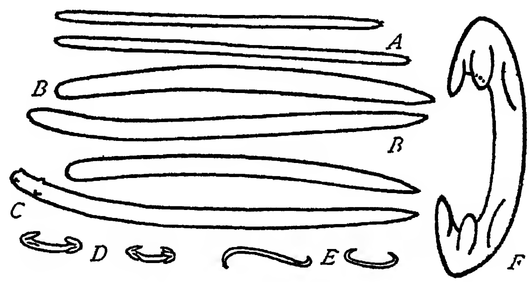

FIGURE 44.—*Myxilla agennes* de Laubenfels: *F*, side view of an anchorate chela, ×1,333; others, ×300

Principal spicules, styles usually curved or bent and usually quite smooth, but now and then with a few spines. Size, 7μ by 155μ to 10μ by 175μ. There are a very few about twice this size that may be foreign. There are also many forms barely 1μ or 2μ thick, which seem to be developmental stages of those mentioned above (fig. 44, *B*, *C*); size, 7μ by 155μ to 10μ by 175μ. Ectosomal spicules, tornotes with ends microspined (fig. 44, *A*); size, 4μ by 145μ to 4μ by 155μ, rare. First miscroscleres, anchorate chelas (fig. 44, *D*, *F*); length, about 27μ, rare. Second microscleres, sigmas (fig. 44, *E*); length, 30μ to 36μ, rare.

Remarks.—This species is remarkable for the almost total loss of all but the styles, and on them of the almost total loss of the characteristic spination. The typical *Myxilla* structure is also almost lost. On the other hand, all the items are there, though in reduced quantity; a few characteristic dermal tornotes properly placed, a few spines in the endospicules, a few characteristic anchorate chelas, a few

sigmas, and bits of the isodictyal reticulation. A little further reduction and one would have a *Hymeniacidon*, which like most every simple sponge genus is probably polyphyletic.

MYXILLA PARASITICA Lambe

Myxilla parasitica LAMBE, 1893, p. 31.

Holotype.—In the Museum of the Geological Survey, Ottawa, Canada.

Type locality.—The west coast of Canada.

Material examined.—One specimen was collected January 11, 1925, in the south end of Monterey Bay, Calif. The University of Southern California collected three: One on April 19, 1929, at Point Fermin, near San Pedro; one without locality data other than depth 30 meters; and one without locality data other than depth 60 meters.

Description (U.S.N.M. No. 21473; B.M. No. 29.9.30.15).—Shape, amorphous. Size, up to 15 mm high, 5 cm in diameter. Consistency, firm. Color in life and when preserved, drab. Oscules, indistinct, liable to confusion with the pores. Pores, at least 200μ in diameter when open. Surface, superficially very irregular; there are smooth places, also even more numerous lumps and depressions.

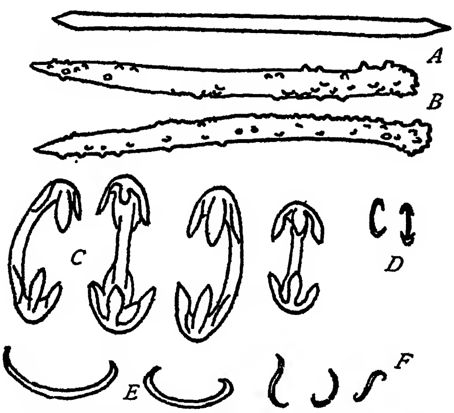

FIGURE 45.—*Myxilla parasitica* Lambe, ×300

Ectosomal specialization obscure, doubtful. Endosomal structure, a typical myxilloid isodictyal reticulation. Histological details: The flagellate chambers are subspherical, about 25μ in diameter.

Principal spicules, acanthostyles (fig. 45, *B*); size, 10μ by 170μ to 15μ by 200μ. Ectosomal spicules, hastate tornotes (fig. 45, *A*); size, 7μ by 170μ to 11μ by 210μ. First microscleres, anchorate chelas (fig. 45, *C*); length, 48μ to 68μ. Second microscleres, anchorate chelas (fig. 45, *D*); length, 14μ to 18μ. Third microscleres, sigmas (fig. 45, *E*, *F*); length, 22μ to 52μ.

Remarks.—The specimen collected by the University of Southern California differs from the Monterey specimens in the shape of the larger chela, its median tooth being very much smaller than the corresponding one in the sponge from central California. This variation within the species is surprising, but the agreement in other ways is so striking that there need be little hesitation in identifying

the two. The resemblance to Lambe's sponge is not complete, but it is still so great that I hesitate to create a new species when the geographical location is so close. The principal spicules of the Canadian sponge range somewhat larger, and it has a distinct category of very short acanthostyles that I do not find in the California specimens. Lambe's description mentions no sigmas more than 26μ. Aside from these items the agreement is very close. This species is rather close to *Myxilla rosacea* Lieberkühn, which is the type species of the genus, a Mediterranean form.

On May 11, 1929, I collected a sponge near Pacific Grove, Calif., that had the megascleres and all the characteristics of *M. parasitica*, but no microscleres. The literature contains very few references to myxillalike sponges without microscleres (see notes under *Myxilla versicolor*), so this occurrence is most remarkable. As *M. parasitica* is probably common in the vicinity, I hesitate to create a new species for this form, but hazard a guess that it was an aberrant growth of *M. parasitica*. It was crowded with embryos, ovoid in shape, about 200μ in diameter.

MYXILLA VERSICOLOR Topsent CALIFORNIANA, new variety

Holotype.—U.S.N.M. No. 21474; B.M. No. 29.8.22.20.

Type locality.—Laguna Beach, Calif., intertidal, March 14, 1926, collected by me.

Description.—Shape, amorphous. Size, 15 mm thick, 5 cm in diameter. Consistency, fragile. Color in life and when preserved, pale drab. Oscules, not evident. Pores, not evident. Surface, superficially tuberculate.

Ectosomal specialization, a dermal membrane; very easily detachable, fleshy, containing abundant tangent tylostrongyles. Endosomal structure, collenchymatous, with spicules in tracts and others in confusion. Histological details: About 90μ below the surface was a layer of very dark cells, which may have been algae. Principal, or ascending, fibers about 40μ in diameter, cored by abundant styles.

Principal spicules, smooth tylostyles (fig. 46, *B*); size, 8μ by 265μ to 12μ by 250μ. There are also a few acanthostyles about 7μ by 150μ (fig. 46, *A*). Ectosomal spicules, tylostrongyles (fig. 46, *D*, *E*); size, 4μ by 240μ to 8μ by 235μ. Interstitial spicules, tylostrongyles, just like the dermal, are found also scattered through the flesh.

Remarks.—The nearest relative of this form seems to be *Myxilla versicolor* Topsent (1893, p. xli), from Banyuls, France (on the Mediterranean coast), which differs in having much larger (400μ) endosomal tylostyles, more so and more usually spined, and in showing a variety of colors not yet found in the Californian form.

Similar species of this genus are reported from nowhere else, the complete absence of microscleres being noteworthy.

As noted under *Myxilla parasitica*, I collected another myxillid sponge in California with no microscleres, rather clearly an aberrant form of a common local species. *Myxilla versicolor* seems the only member of the group definitely attended with such a deficiency, and equally well marked by the peculiar dermal spicule.

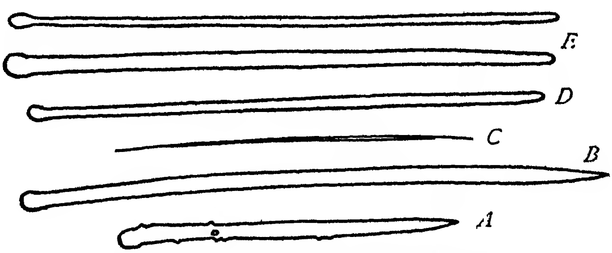

FIGURE 46.—*Myxilla versicolor* Topsent *californiana*, new variety, ×300. *C*, problematical spicule, probably a very early stage of the megascleres, perhaps an uncommon microsclere (a rhaphide)

In *M. versicolor californiana* the dermal spicules are also numerous in the endosome, and the typical *Myxilla* reticulation is lacking. This latter may or may not be true for the Mediterranean form, all of Topsent's specimens having been very thin incrustations.

Genus IOPHON J. E. Gray

IOPHON CHELIFER Ridley and Dendy CALIFORNIANA, new variety

Holotype.—U.S.N.M. No. 21401; B.M. No. 29.9.30.7.

Type locality.—A handful of fragments of this sponge was dredged by the University of Southern California on December 27, 1916, south of San Pedro, Calif., depth 48 meters.

Description.—Shape, amorphous. Size, the largest fragment is about 2 cm in diameter; the size of the complete sponge (colony) can not be ascertained. Consistency, fragile. Color in alcohol, very dark brown. Oscules, very irregular; diameter, about 1 mm. Pores, minute. Surface, superficially very lumpy and irregular.

Ectosomal specialization, a dermal membrane; it is fleshy, not easily detachable, and contains few spicules. The tylotes are bunched irregularly at or near the surface. Endosomal structure, "crumb-of-bread," with a dense myxilloid isodictyal reticulation of acanthostyles, cemented together by a small quantity of spongin at the nodes.

Principal spicules, acanthostyles (fig. 47, *A*); size, 12μ by 265μ to 13μ by 290μ. Ectosomal spicules, tylotes with heads microspined (fig. 47, *C*); size, 6μ by 250μ to 8μ by 240μ. Interstitial spicules, smooth styles (fig. 47, *B*); about 3μ in diameter; they are probably

developmental stages of the principal spicules. First microscleres, palmate anisochelas (fig. 47, *G*); length, 15μ to 33μ. Second microsclere, bipocillates (fig. 47, *E*); length always very close to 15μ, the shorter illustrations in the figure being end views.

Remarks.—This form differs from the typical species in having all its spicules, except the palmate anisochelas, somewhat smaller.

Lambe (1893, p. 30) describes sponges from the Pacific coast of Canada as *Iophon chelifer*, which should be regarded as synonymous with the new variety. Wilson (1904, p. 143) records sponges from

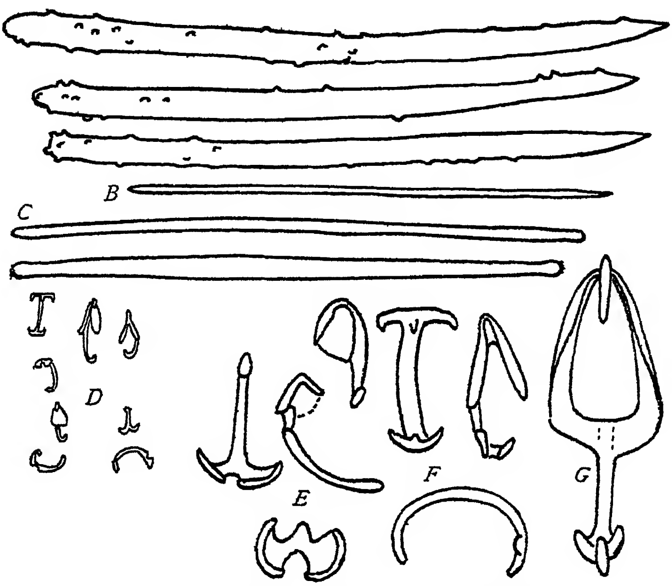

FIGURE 47.—*Iophon chelifer* Ridley and Dendy *californiana*, new variety: *E–G*, ×1,333; others, ×300. *F*, above and below, spicules more suggestive of anchorate chelas than of bipocillates. Such series as this, very easily noted in microscopical preparations of *Iophon*, point to the pathogenic distortions of chelas

the eastern tropical Pacific (*Albatross* Station 3384) as *chelifer*. variety *ostia-magna*. This seems not so close to the Californian form as Lambe's. The type of the species is from subantarctic waters (Ridley and Dendy, 1886, p. 349).

Genus TEDANIA J. E. Gray

TEDANIA TOPSENTI [6] de Laubenfels

Tedania topsenti DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21490; B.M. No. 29.8.22.2.

Type locality.—Just below low-tide mark at Pescadero Point, near Carmel, Calif., July, 1926; the holotype and several other specimens were all collected by me.

[6] Named for Prof. Emile Topsent, of the University of Strasbourg.

Description.—Shape, massive to encrusting. Size, up to 3 cm thick and more than 3 cm in diameter. Consistency, spongy. Color in life, reddish orange; preserved, very pale drab. Oscules, diameter 0.8 to 1.1 mm. Pores, not evident. Surface, superficially smooth with numerous tubercles less than 1 mm high.

Ectosomal specialization, a dermal membrane; it is exceedingly thin and difficult to detach intact, and it contains tangentially placed tornotes. Endosomal structure, "crumb-of-bread," with spicules in confusion. When collected the numerous embryos were conspicuous by their bright red color; they were subspherical and 220μ to 270μ in diameter. Histological details: The flagellate chambers are subspherical, 32μ to 40μ in diameter.

Principal spicules, subtylostyles (fig. 48, *B*); size, about 11μ by 250μ. Ectosomal spicules, tylotes (fig. 48, *A*); size, about 8μ to 200μ. Microscleres (?), rhaphides (fig. 48, *C*); size, about 2μ by 180μ.

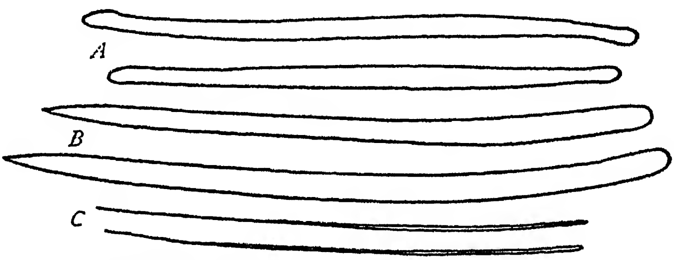

FIGURE 48.—*Tedania topsenti* de Laubenfels, ×300

Remarks.—As compared to the other local *Tedania*, *T. toxicalis*, this form differs markedly in general appearance and color. It has fewer and thicker rhaphides; its endosomal subtylostyles are half again as thick; and the shape of the dermal tornotes of *topsenti* is quite peculiar. They are notable for the swollen shape of the central part of the shaft. The spicules here called rhaphides are not at all the rhaphides typical of the genus *Tedania*, but instead are possibly merely very young forms of the two sorts of megascleres. The general structure, however, and the spiculation of dermal tornotes over smooth styles are by definition *Tedania*. One isochela was found in a boiled-out spicule preparation, but several other similar preparations were made and they and several sections of the sponge itself were studied very carefully without the discovery of any more; it was doubtless foreign, but its occurrence should be recorded in view of the faint suggestion of resemblance to *Lissodendoryx*. One might use *Kirkpatrickia* but for the very distinctive architecture of the one species (*K. variolosa*) of that genus.

TEDANIA TOXICALIS de Laubenfels

Tedania toxicalis DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21492; B.M. No. 29.8.22.24.

Type locality.—Point Pinos, Pacific Grove, Calif., intertidal, July, 1925, collected by me. In 1925 this species was abundant in one place and about a dozen specimens were collected, all within a range of a few square meters. In 1926, only a few specimens were observed at the same place, and at no time have I found any in any other locality.

This species was found associated with *Phyllospadix*, growing around the bases of the stems of this seaweed.

Description.—Shape, massive; a compound of smoothly rounded parts resembling masses of foam or froth. Size, 3 cm high, 5 cm in diameter. Consistency, softly fragile. Color in life, brownish red; preserved, very pale drab. Oscules, not readily made out, as the surface has numerous pits, from 1.5 to 3 mm in diameter; some of these may be due to seaweed that grew through the sponge, others but "blind" depressions, others oscules, and some of the smaller may be large inhalent apertures. Pores, not evident. Surface, superficially smooth with numerous cavities as noted above.

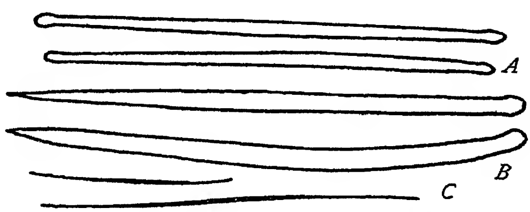

FIGURE 49.—*Tedania toxicalis* de Laubenfels, ×300

Ectosomal specialization, a dermal membrane; this is fleshy, detachable, about 20μ thick, and contains tangentially placed tylotes. Endosomal structure, "crumb-of-bread," with numerous cavities about 1 mm in diameter surrounded by spicules tangent to their periphery, and in places vague tracts of spicules. Principal tracts about 30μ in diameter.

Principal spicules, subtylostyles (fig. 49, *B*); size, 2μ by 100μ to 7μ by 200μ. Ectosomal spicules, tylotes (fig. 49, *A*); size, 8μ by 200μ to 14μ by 200μ. Microscleres, smooth rhaphides (fig. 49, *C*); size, about $\frac{2}{3}\mu$ by 150μ.

Remarks.—This is sharply marked off from most species of the genus by the tylote nature of its parenchymal monaxons. It has another striking character, its evident toxic nature, which may or may not be present in other species, as most lack descriptions of their characteristics when freshly collected. If a specimen of it be placed in a bucket with other living sea animals, as for example, fish, crabs, mollusks, and worms, in an hour or less they are observed to die, while in controls lacking the sponge they survive.

This is interesting enough to warrant much further investigation, but since 1926 I have been unable to locate any more examples of this species.

Genus TEDANIONE Wilson

TEDANIONE OBSCURATA de Laubenfels

Tedanione obscurata DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21494; B.M. No. 29.8.22.25.

Type locality.—The one specimen is from my personal collection, taken at Point Pinos, Pacific Grove, Calif., July, 1925, intertidal. It was completely covered by a thin growth of a compound ascidian of the family Diademnidae.

Description.—Shape, amorphous. Size, 25 mm high, 5 cm in diameter. Consistency, mediocre. Color in life and when preserved, drab. Oscules, slightly less than 1 mm in diameter. Pores, not evident because of the overlying ascidian. Some of the openings resembling oscules may really be inhalent. Surface, covered as described above.

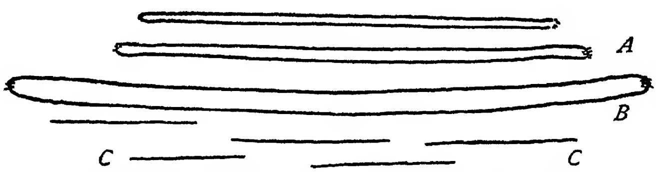

FIGURE 50.—*Tedanione obscurata* de Laubenfels, ×300

Ectosomal specialization, none. Endosomal structure, "crumb-of-bread," with abundant scattered spicules in confusion.

Principal spicules, tylotes to strongyles with heads microspined (fig. 50, *A*, *B*); size, 6μ by 200μ to 12μ by 300μ. Microscleres, rhaphides (fig. 50, *C*); size, about 2μ by 80μ.

Remarks.—In boiled-out spicule mounts one finds a few smooth styles, not shown in the figure. As these are very uncommon and do not show up in the sections of the sponge itself, they are probably foreign, yet they deserve mention. If they are proper, this would be a *Tedania*, having almost the entire sponge given over to ectosomal skeleton. Since this specimen had the ectosome proper replaced by the ascidian above mentioned, this is all quite puzzling.

The nearest relative of this form seems to be *T. wilsoni* Dendy, 1922, from the Indian Ocean, which differs in having all its spicules about half as thin as the California form; it also had distinct tracts and in general a more orderly structure. It, of course, was not combined with an ascidian, but was a thin crust on a hexactinellid sponge.

Family HYMEDESMIIDAE Topsent

Genus HYMENAMPHIASTRA de Laubenfels

Hymenamphiastra may be defined as differing from *Hymetrochota* in having unsymmetrical desmalike amphiasters instead of symmetrical birotulates. Genotype and only species: *Hymenamphiastra cyanocrypta.*

HYMENAMPHIASTRA CYANOCRYPTA de Laubenfels

Hymenamphiastra cyanocrypta DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21455; B.M. No. 29.8.22.18.

Type locality.—Point Pinos, Pacific Grove, Calif., July, 1925, collected by me. In July, 1929, I searched for this species, but did not find it. Several other investigators, however, discovered it, and according to their description it was in the same locality as in 1925, one sufficiently difficult to locate that I had missed it. Judged from their remarks, the colony had more than doubled in size during the four years elapsing. This species has an unusual habitat. There are numerous rounded granite bowlders piled one above the other, the top layer exposed only at very low tides. This top layer bears abundant life, but if one lifts many stones it is observed that the deeper ones are bare of life; they are, of course, in the dark. It was while investigating to see if any life at all occurred in these depths that this species was discovered. Though in 1925 it was found only about 60 cm below low-tide mark, in 1929, by enlarging its area, it had come up within 20 cm of that point.

Description.—Shape, encrusting. Size, less than 1 mm thick but spreading laterally from stone to stone so that probably more than a square meter was covered. Consistency, mediocre. Color in life, rich dark cobalt blue, growing gradually paler and paler in alcohol; after four years much blue remains. Oscules, not evident. Pores, at least 10μ in diameter; perhaps larger when expanded. Surface, superficially velvety.

Ectosomal specialization, a dermal membrane only some 7μ thick, not easily detachable, fleshy, containing very few spicules. There are extensive subdermal spaces of great variation in size, some more than 100μ deep. Endosomal structure, at the base of the sponge, where it is in contact with the substratum, there is a thin layer of spongin, at least 10μ thick, perhaps much more. Many of the acanthostyles have their heads embedded in this, very nearly perfectly perpendicular to the substratum. Above this is a zone where some of the acanthostyles are strewn in confusion. Above this, near

the surface, is a zone where there are few acanthostyles, instead tornotes (subtylotes with hastate ends) in bundles and in confusion. Histological details: Some at least of the flagellate chambers are about 18μ in diameter. Throughout the sponge, but especially in the ectosomal regions, there are abundant dark blue spiral microbes. 4μ or 5μ long and about ½μ thick, very probably symbionts, and certainly responsible for the blue color of the sponge. Bowerbank's *Hymeniacidon gelatinosa* (1866, p. 222, probably a *Laxosuberites*) and a sponge, perhaps identical, which Carter (1882, p. 355) identified as *Terpios coerula*, have very similar color and symbionts. Carter called these microbes *Hypheotrix coerula*. Topsent (1900, p. 199) says that he submitted them to M. Lignier, professor of botany at the University of Caen, who identified them as *Beggiatoa alba* var.

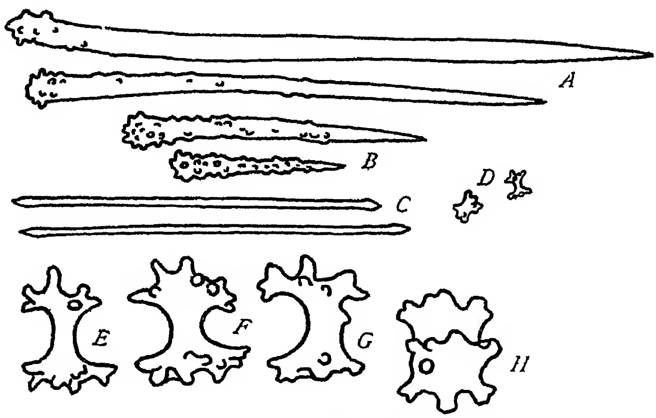

FIGURE 51.—*Hymenamphiastra cyanocrypta* de Laubenfels: *A–D*, ×300; others, ×1,333 *H*, one of the peculiar microscleres in end view

marina Cohn. Recent taxonomic botany does not admit any colored forms to the genus *Beggiatoa*.

Principal spicules, acanthostyles (fig. 51, *A*, *B*); size, 10μ by 75μ to 13μ by 280μ. Ectosomal spicules, tornotes (fig. 51, *C*); size, 3μ by 160μ to 3μ by 170μ. Microscleres, amphiasters (fig. 51, *D–H*); length, 10μ to 11μ.

Remarks.—The amphiasters are located abundantly throughout the sponge and might be regarded as greatly modified birotulates, but oftenest they closely resemble desmas. In one place in this sponge were found some anchorate isochelas 26μ long, some others 36μ long, and some sigmas about 16μ long. From their exceedingly local distribution, these would seem branded as foreign inclusions, but they are worthy of mention in view of the indicated relationships.

This form is obviously most clearly related to *Hymetrochota rotula* Topsent (1904, p. 168), type species of and only species in the

genus. If separate genera, such as *Lissodendoryx* and *Myxilla* are to be established upon a distinction of chela form, the Californian form with its contort desmalike obscure birotulates deserves a separate genus from *Hymetrochota*. *H. rotula* has megascleres much larger than those in *Hymenamphiastra*, and has neat symmetrical birotulates of the *Iotrochota* type. Reference to the anchorate chelas and the sigmas found in one place in *H. cyanocrypta* is interesting, because that portion exactly answers to the description of Bowerbank's *Hymedesmia*. *Hymenamphiastra*, *Hymetrochota*, *Hymedesmia*, and *Hymesigma* are clearly very closely related.

Genus ANAATA de Laubenfels, new name

Aaata de Laubenfels, 1930, p. 27 (preoccupied).

The genus *Anaata* may be characterized as of the family Hymedesmiidae, with smooth monaxons in the ectosome, spiny monaxons in the endosome, and isochelas as microscleres. Genotype: *Anaata spongigartina*.

ANAATA SPONGIGARTINA de Laubenfels

Aaata spongigartina de Laubenfels, 1930, p. 27.

Holotype.—U.S.N.M. No. 21428; B.M. No. 29.8.22.13.

Type locality.—Pescadero Point, near Carmel, Calif., May 11, 1929, intertidal, collected by me. At this locality is a spot, readily recognized from year to year, where there has been a growth of this sponge since 1925. It must either persist or recur regularly with brief absences; the former theory appearing much the more plausible. I know of only this one colony of this species in central California. On July 18, 1914, the University of Southern California collected this species on the wood pilings of the "Long Wharf," which was at Santa Monica, in southern California. Their specimen resembles the type to the most minute details that I could observe.

Description.—Shape, encrusting. Size, 5 mm thick and about 4 by 10 cm in area as growing. The specimens removed were but portions of this. Consistency, spongy. Color in life, rich brown, slightly reddish; preserved, very pale drab. Oscules—pores—craterlike openings over the entire surface, about one to each four square millimeters. Only the one sort of opening could be observed, and no decision is given as to whether all are exhalent or some inhalent. Each crater is externally a subspherical pit about 200μ in diameter surrounded by sphinctrate contractile tissue. This does not operate so as to obliterate the pit by contraction, but as follows: At the rim of the crater is a palisade of very straight subtylostyles, points outward, about 100μ of each extending beyond the protoplas-

mic structures. With contraction of the sphincter these spicules are tilted inward till their points almost or quite meet at an apex, creating a conical shield or cap over the aperture. At the base of the chamber there is typically a constriction, so that the opening from it to the ramifying canals of the endosome is only about 100μ in diameter. I have never observed the complete closure of the cap above referred to, at the least an opening of 100μ being left, but it may be assumed that upon appropriate stimulation, as perhaps by attempted entrance of some enemy, complete closure would be possible.

Surface, superficially smooth, with projections as described above.

Ectosomal specialization, spiculous; about 100μ to 200μ thick of spicules (principally the straight smooth subtylostyles) felted together exceedingly densely so there is room for but a minimum of

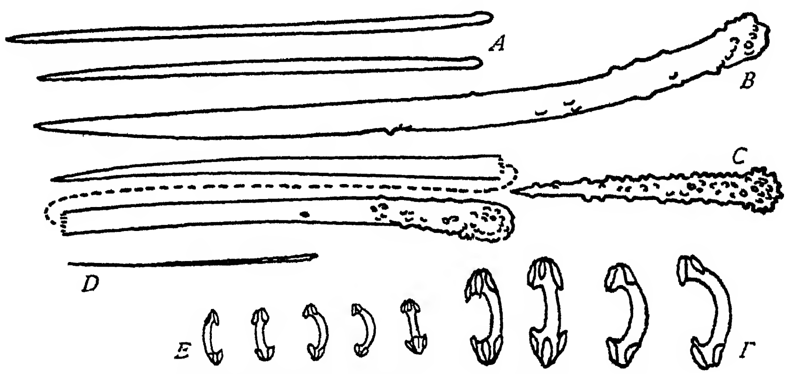

FIGURE 52.—*Anaata spongigartina* de Laubenfels, ×300

protoplasm. This makes an almost solid siliceous armor. From the difficulty in tearing or cutting this layer, one may guess the presence of spongin, but no evidence of it could be noted in sections. Endosome, a rather dense protoplasmic structure, with moderately numerous acanthotylostyles, typically perpendicular to the substratum, points upward. Histological details: There are flagellate chambers up to nearly 50μ in diameter.

Ectosomal spicules, subtylostyles (fig. 52, *A*); size, 6μ by 190μ to 5μ by 210μ. Endosomal spicules, acanthotylostyles (fig. 52, *B*, *C*); size, 13μ by 115μ to 13μ by 390μ. First microscleres, arcuate isochelas (fig. 52, *F*); length, 42μ to 50μ. Second microscleres, arcuate isochelas (fig. 52, *E*); length, 23μ to 25μ.

Remarks.—The nearest relative of this species would seem to be *Leptosiopsis* Topsent (1927, p. 13), type species *L. inaequalis*. This has anisochelas of the anchorate type and is much subject to deformation, thus separating that genus from *Anaata* decidedly. *L. inaequalis* has its ectospicules often polytylote and its endospicules

almost twice as large as those of *spongigartina*. The peculiar nature of the orifices of *spongigartina* is most noteworthy.

Another genus worthy of mention here is *Leptosastra* Topsent (1904, p. 194), type species *L. constellata*, which has astrose microscleres instead of the chelas. If these asters be derived from such deformed chelas as are found in *Leptosiopsis*, and the chelas of *Leptosiopsis* be regarded as deformities of the symmetrical ones of *Anaata*, then these three genera might be regarded as a linear series. This is, of course, mere speculation.

ANAATA BREPHA de Laubenfels

Aaata brepha DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21427; B.M. Nos. 29.8.22.36, 29.8.22.57.

Type locality.—Pescadero Point, near Carmel, Calif., intertidal. May 11, 1929, collected by me. It was growing over the shell of a *Hinnites* (a large sessile bivalve mollusk). The locality was about 5 meters from that of the holotype of *Anaata spongigartina.*

Description.—Shape, encrusting. Size, well under 1 mm thick, and covering a shell about 7 cm in diameter. Consistency, mediocre. Color in life, salmon red; dry, brownish red; in alcohol, pale flesh color. The *Hinnites* was full of minute ova and was extruding these at the time of collection. The sponge was exactly the same color as these eggs. Oscules, not evident. Surface, superficially smooth but following the very rough contours of the shell of the scallop.

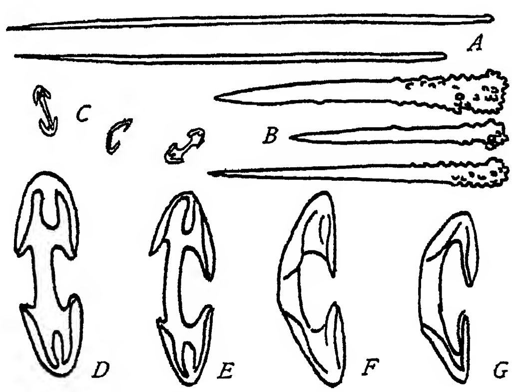

FIGURE 53.—*Anaata brepha* de Laubenfels: *A–C*, ×300; others, ×1,333

Ectosomal specialization, not discernible because of the extreme thinness of the sponge. The styles were very definitely dermal, however. Endosomal structure, no order discernible (note above), because of the thinness of the incrustation and the great irregularity of the substrate.

Ectosomal spicules, styles (fig. 53, *A*); size, 3μ by 190μ to 3μ by 210μ. Endosomal spicules, acanthotylostyles (fig. 53, *B*); size, 8μ by 95μ to 8μ by 130μ. Microscleres, arcuate isochelas (fig. 53, *C–G*); length, 17μ to 21μ.

Remarks.—The nearest relative of this form seems to be *Anaata spongigartina* from the same locality, which differs in having a second (larger) size range of chelas, and much larger megascleres. *A. brepha* also fails to show the very peculiar apertures of *spongigartina*, perhaps because of its exceedingly thin size. Various conjectures naturally arise. Is this but an immature form of *spongigartina?* Monaxon sponges are not known to show pronounced increase in spicule size with age. Are the differences due to some such ecological item as food, for example? We absolutely do not know, and consequently, in view of the very distinct differences, I make a new species for this, particularly because of the distinct difference in chela *shape* between the two forms, a difference seldom seen within a species.

Family EURYPONIDAE Topsent

Genus EURYPON J. E. Gray

EURYPON ASODES de Laubenfels

Eurypon asodes de Laubenfels, 1930, p. 27.

Holotype.—U.S.N.M. No. 21442; B.M. 29.8.22.29.

Type locality.—Pescadero Point, near Carmel, Calif., intertidal, May 11, 1929, collected by me.

Description.—Shape, encrusting. Size, 0.2 to 0.5 mm thick; the incrustation in the field covered a space about the size of a hand, but the largest specimens obtainable were about 1 cm in diameter. Color in life, rich yellow; preserved, pale drab. Oscules, punctiform, diameter about 100μ, abundant. Pores, not evident, or confused with the oscules. Surface superficially smooth, slimy.

Ectosomal specialization, vague. Endosomal structure, there is a basal layer of what seems to be spongin, in which are embedded, *Hymedesmia*-like, the heads of acanthostyles of two sorts. There are larger, less spiny ones, and shorter more spiny ones. Free in among the protoplasmic structures are very numerous long straight smooth tylostyles and abundant microscleres.

Principal spicules, acanthostyles (fig. 54, *B*); size, 8μ by 100μ to 13μ by 345μ. Interstitial spicules, tylostyles (fig. 54, A); size, 3μ by 180μ to 4μ by 250μ. Microscleres, palmate isochelas (fig. 54, *C–E*); length, 3μ to 13μ.

Remarks.—The nearest relatives of *asodes* seem to be *Eurypon microchela* Stephens (1916, p. 240), where stress is laid upon the chelas being as small as 8μ. *E. microchela* is from about 1,000 meters depth off the coast of Ireland. Its megascleres are more than twice the size of those of *asodes*, in addition to the difference in microscleres. Another species worthy of mention here is Thiele's *Micro-*

ciona discreta (Thiele, 1905, p. 447) from the coast of Chile. It has toxas as well as chelas, which latter we note are remarkably small (8μ), and its spicules, other than the dermal, are much thicker than those in *asodes*. It also differs in having plumose ascending columns of spicules. Topsent (1914, p. 618) made this the type of his genus *Dictyciona*. That this genus is synonymous with *Eurypon* may well be argued.

The smallness of the chelas of *asodes* is phenomenal. Very accurate measurement showed many as small as 0.0035 mm in total length. Whitelegge (1906, p. 471), describing *Esperiopsis canaliculata*, lists chelas 0.0014 mm long, but does not speak in his text as if

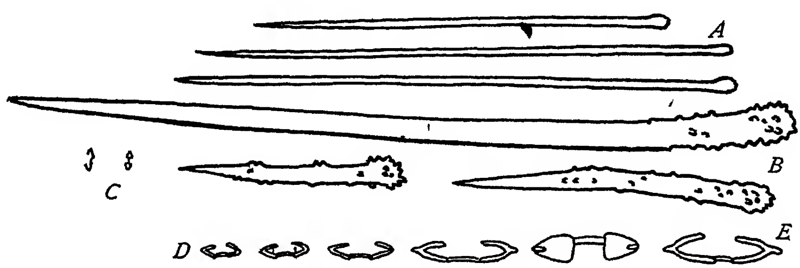

FIGURE 54.—*Eurypon asodes* de Laubenfels: *A–C*, ×300; others, ×1,333

they were at all marvelous; one is very much inclined to believe it a misprint for 0.014 mm; if not, that is the only instance I can find of smaller microscleres than these remarkable ones of *Eurypon asodes*.

Family MICROCIONIDAE[6]

Genus MICROCIONA Bowerbank

MICROCIONA MICROJOANNA de Laubenfels

Microciona microjoanna DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21468; B.M. No. 29.8.22.28.

Type locality.—Pescadero Point, near Carmel, Calif., May 11, 1929, collected by me. The species is moderately common in central California, and there was a specimen in the collection of the University of Southern California. This latter was taken near Point Vincente, July 5, 1924, depth 18 meters, and is U.S.N.M. No. 21406.

Description.—Shape, encrusting. Size, up to 2 cm thick, 7 cm in diameter. Consistency, firm, slightly spongy. Color of holotype in life, brilliant scarlet; that collected from the same locality in 1926 was a beautiful rich pink. That collected by the University of Southern California bore no notation of color in life. All fade to drab in preservatives. Oscules, round, scattered, with sphinctrate membrane; diameter 1.5 mm; they are found only where the sponge

[6] For Clathriidae Hentschel, because *Microciona* supplants *Clathria*.

is thicker than 15 mm. Pores, 60μ to 75μ in diameter; abundant over the entire surface. Surface, superficially pilose, with spicules.

Ectosomal specialization, vague. There seem to be no special ectosomal spicules, unless those rated as interstitial may be so regarded; their location is definitely down amidst the endosomal structures, however. Endosomal structure, predominantly protoplasmic, with ascending plumose columns of smooth styles, sparsely echinated by small acanthostyles. Numerous slender subtylostyles are scattered in the flesh and protrude from the surface. Histological details: The abundant flagellate chambers are about 30μ in

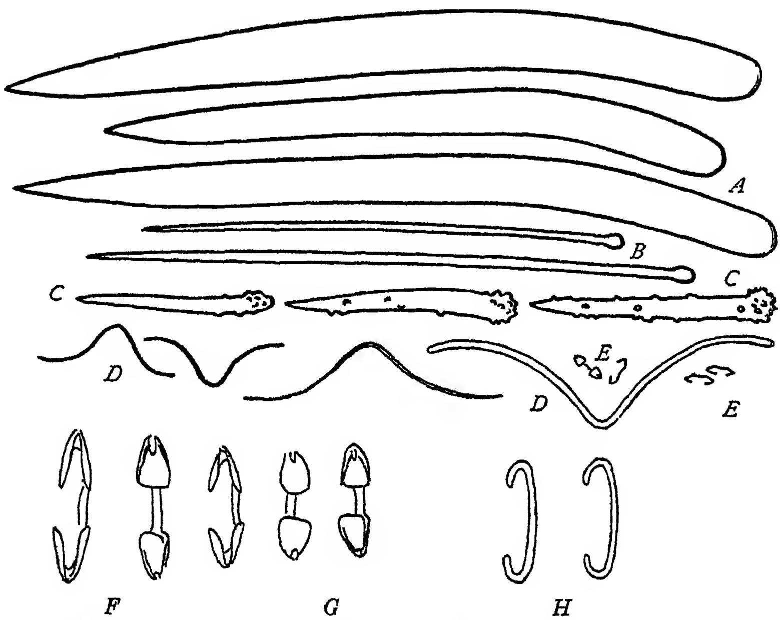

FIGURE 55.—*Microciona microjoanna* de Laubenfels: *A–E*, ×300; others, ×1,333

diameter. Ascending fibers, about 300μ in diameter, containing little spongin.

Interstitial spicules, subtylostyles (fig. 55, *B*); size, 3μ by 205μ to 4μ by 260μ. Coring spicules, smooth styles (fig. 55, *A*); size, 20μ by 280μ to 27μ by 330μ. Echinating spicules, acanthostyles (fig. 55, *C*); size, 5μ by 85μ to 10μ by 100μ. First microscleres, palmate isochelas (fig. 55, *E–G*); length, 12μ to 16μ. Second microscleres, toxas (fig. 55, *D*); length 60μ by 140μ. Third microscleres, peculiar sigmoid siliceous bodies present in small numbers in boiled-out samples of the specimen collected in 1926 (fig. 55, *H*); they may not be proper and may have some connection with the chelas, but satisfactory explanation of them is not now at hand.

Remarks.—There is a group of sponges, characterized, among other features, by fibers cored with smooth monaxones and echinated by

spiny monaxons, usually with toxas and palmate isochelas for microscleres; the generic name *Clathria* has usually been employed for this group. *Clathria* was erected by Schmidt (1862, p. 57), and the genotype fixed by Vosmaer (1885, p. 356) as *C. coralloides* Schmidt. Schmidt's description says quite plainly that his sponge had only smooth spicules. Topsent (1925, p. 645) described a sponge that he assumed to be the *coralloides* of Schmidt and that had smooth monaxons, toxas, and palmate isochelas. Topsent's identification may be correct, but one can not be certain; Schmidt mentions no microscleres in his species at all, for example. Both Schmidt's and Topsent's species, however, are clearly congeneric with the group usually called *Ophlitaspongia*, and not with that called *Clathria*.

Shall we drop *Ophlitaspongia* in favor of *Clathria?* Both were published in 1862, *Clathria* in the latter part of the year. Unless definite evidence is forthcoming to show that *Ophlitaspongia* was published yet later, I propose to retain it.

Microciona Bowerbank (1862, p. 1109), genotype *M. astrosanguinea* Bowerbank, differs from so-called *Clathria* only in external form, being encrusting instead of with branching and anastomosing projections. It will be noted, however, that juvenile specimens of the so-called *Clathria* are often encrusting, that the encrusting form is very often the result of environmental factors such as strong currents, and that some species well established as *Microciona*, for example, *M. prolifera* Verrill, with old age assume the clathrous shape. I see no reason for maintaining separate genera for such insignificant differences, and propose that the whole group be termed *Microciona*.

The most distinctive items about *M. microjoanna* are the very large size of the coring spicules and the fact that they are stylote, instead of subtylostylote.

MICROCIONA PARTHENA de Laubenfels

Microciona parthena DE LAUBENFELS, 1930, p. 27.

Holotype.—U.S.N.M. No. 21383; B.M. No. 29.9.30.6.

Type locality.—Point Vincente (near San Pedro), Calif., depth 26 meters, November 15, 1924, dredged by the University of Southern California. A second specimen (U.S.N.M. No. 21397) was taken the same day and at the same locality, but at 32 meters. A third was dredged south of San Pedro, depth 45 meters, other data lacking.

Description.—Shape, amorphous to encrusting. Size, up to 2 cm thick, 4 cm in diameter. Consistency, mediocre. Color in life, red; in alcohol, drab. Oscules and pores, not evident. Surface, superficially tuberculate, the tubercles hispid.

Ectosomal specialization, vague or wanting. Endosomal structure, a mass of plumose ascending columns, scarcely connected with

one another except at the base. Principal, or ascending, fibers about 200μ in diameter.

Interstitial spicules, subtylostyles (fig. 56, *B*); size, 3μ by 260μ to 5μ by 300μ. Coring spicules, smooth styles (fig. 56, *A*); size, 27μ by 350μ to 33μ by 430μ to 30μ by 475μ. Echinating spicules, acanthostyles (fig. 56, *C*); size, 5μ by 100μ to 8μ by 108μ. First microscleres, palmate isochelas (fig. 56, *D*); length, 24μ to 28μ. Second microscleres, large toxas (fig. 56, *F*); size, 3μ by 40μ to 7μ by 72μ. Third microscleres, small toxas (fig. 56, *E*); length, 14μ to 22μ.

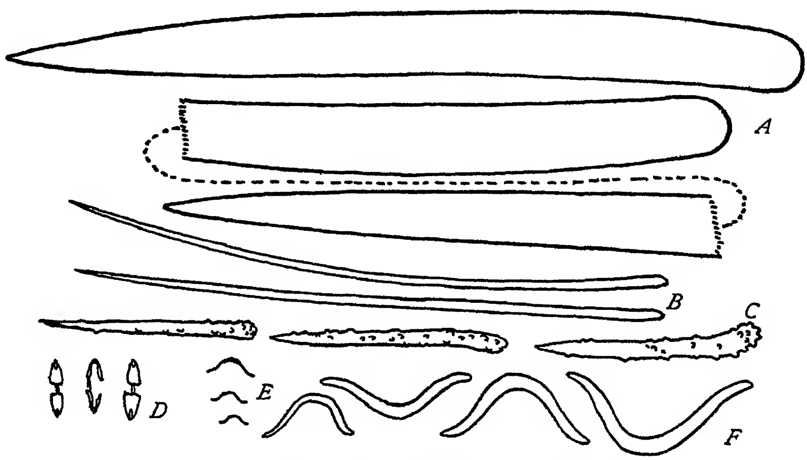

FIGURE 56.—*Microciona parthena* de Laubenfels, ×300

Remarks.—The nearest relative of this form seems to be *Microciona microjoanna* from central and southern California, which differs in having chelas of very different shape, toxas of only one size range, a quite different shape, and coring styles very much smaller.

Genus CLATHRIOPSAMMA Lendenfeld

CLATHRIOPSAMMA PSEUDONAPYA de Laubenfels

Clathriopsamma pseudonapya DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21436; B.M. No. 29.8.22.19.

Type locality.—The one specimen is from Pacific Grove, Calif., intertidal, June 30, 1926.

Description.—Shape, encrusting. Size, up to 1 cm thick, 4 cm in diameter. Consistency, spongy to fragile. Color in life, yellow; preserved, pale drab. Oscules and pores, not evident. Surface, superficially smooth, with irregularly scattered conules about 1 mm high.

Ectosomal specialization, a dermal membrane, about 50μ thick; it is fleshy, detachable, and contains some tangent spicules of the sorts

found in the endosome. Endosomal structure, mostly sand. For further details, see notes given below concerning spicule locations.

Interstitial spicules, tylostyles (fig. 57, *A*); size, 8μ by 330μ to 8μ by 355μ, heads microspined. These occur in sparsely scattered fascicular bundles or tracts in the endosome, points toward the surface, also scattered without order in the ground substance, and most abundantly scattered tangentially in the ectosome. Echinating spicules, acanthostyles (fig. 57, *C*); size, 5μ by 60μ to 7μ by 70μ. First microscleres, toxas (fig. 57, *D*); length, 40μ to 72μ. Second microscleres, microxeas (fig. 57, *E*); size, ⅕μ by 52μ to ⅘μ by 65μ.

Remarks.—This species is assigned to *Clathriopsamma* with much hesitation, that genus being poorly known. It was created by von Lendenfeld in 1888 (p. 227), type species *C. reticulata*, according to Hallmann (1920, p. 771). Lendenfeld's description is, of course,

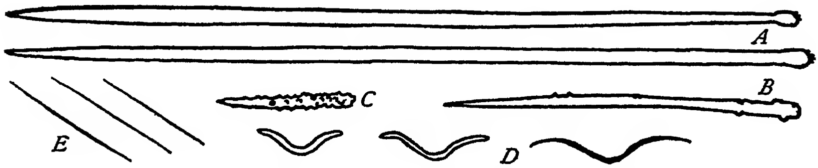

FIGURE 57.—*Clathriopsamma pseudonapya* de Laubenfels, ×300. *B*, an uncommon spicule intermediate between the other two megascleres

worthless. Hallmann's redescription is as good as possible in view of the damaged condition of the specimen.

C. pseudonapya has too elaborate a dermis to be a *Microciona*, and because its dermal spicules are tangent instead of perpendicular and as large as, instead of smaller than, the endosomal it can not be *Eurypon*. *Fusifer* is of great interest here, as it has also the sand inclusions. Its megascleres are all very small, however, and it has distinctive shuttle-shaped microxeas instead of the exceedingly thin ones of *pseudonapya*.

Genus JIA de Laubenfels

This genus may be characterized by peculiar microscleres shaped like the letter J, one end blunt and the other of ultimate fineness. The known species has also chelas and toxas. The megascleres are monaxons (partly acanthose) in confusion. Genotype and only species: *Jia jia*.

JIA JIA de Laubenfels

Jia jia DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21510; B.M. Nos. 29.8.22.30.

Type locality.—The one specimen is from Monterey Bay, Calif., depth 700 meters, collected May 9, 1929, by E. F. Ricketts. The

sponge was growing on a macerated dictyonine hexactinellid skeleton.

Description.—Shape, encrusting. Size, 8 mm thick, 3 by 6 cm in area. Consistency, very fragile. Color in life, drab with a distinct tinge of orange; dry, dull, drab. Oscules and pores, not evident. Surface, superficially wavy, the ridges about 2 mm high and 3 to 4 mm from crest to crest.

Ectosomal specialization vague, but probably to be characterized as a dermal membrane. Endosomal structure, "crumb-of-bread," with the spicules in complete confusion.

Principal spicules, styles, usually smooth, but occasionally with a few large spines (fig. 58, *B*); size, 18μ by 340μ to 33μ by 415μ. In-

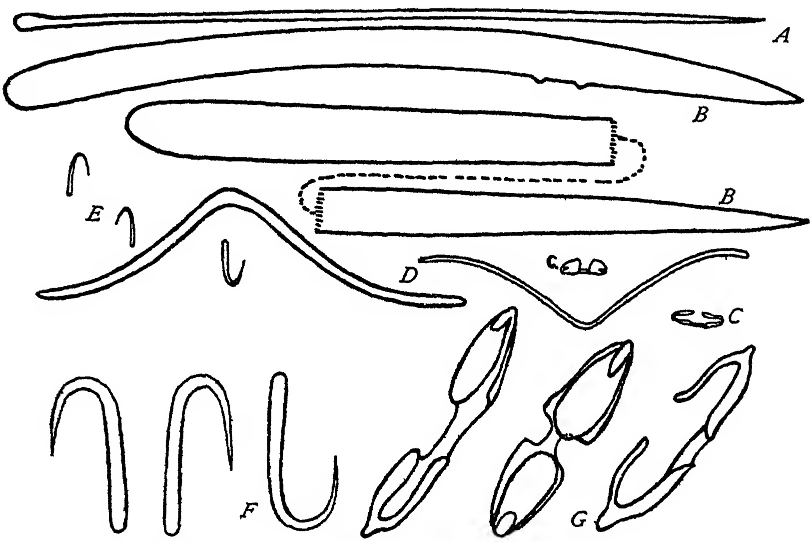

FIGURE 58.—*Jia jia* de Laubenfels: *F*, *G*, ×1,333; others, ×300

terstitial spicules, tylostyles (fig. 58, *A*); size, about 5μ by 330μ. First microscleres, palmate isochelas (fig. 58, *C*, *G*); length, 24μ to 29μ; they are quite markedly contorted. Second microscleres, toxas (fig. 58, *D*); length, 145μ to 190μ. Third microscleres, J-shaped (fig. 58, *E*, *F*); the length from the large end to the bend is between 16μ and 17μ, with very little variation. The entire microsclere if straightened out would probably be 30μ to 35μ long. At the thicker, longer branch they reach a diameter of about 0.0015 mm and terminate in a rounded shape like a microstyle. Throughout their length they grow progressively finer, so that even with oil immersion it is impossible to see exactly where they end, the slender branch growing finer and finer down to the limit of vision. This is most extraordinary. They are very nearly in one plane, not contort.

Remarks.—The nearest approach to the peculiar microsclere of this genus seems to be the sigmas of the sponge described as *Dendoryx luciensis* Topsent (1889, p. xxxvii).

The closest genus to this one seems to be *Amphilectus*. This has been used as such a "catch-all," however, that one awaits a revision of it before using it with confidence. The most remarkable microscleres afford ample ground for a new genus here, and the other structures are rather peculiar, too. The lack of order and plan, plus spicules partly smooth, partly acanthose yet not showing indications of echinate architecture, together with the palmate chelas and toxas, are all novel.

Genus ISOCIONA Hallmann

ISOCIONA LITHOPHOENIX (de Laubenfels)

Plocamia lithophoenix DE LAUBENFELS, 1927, p. 263.

Holotype.—U.S.N.M. No. 21460; B.M. No. 29.8.22.42.

Type locality.—Pacific Grove, Calif., intertidal, July, 1925, collected by me. The species is abundant in central California, and the University of Southern California had three specimens from the southern part of the State, all without depth record and possibly intertidal. They were taken as follows: Santa Catalina Island, March 21, 1915, and April 1, 1915; and Whites Point (near San Pedro), August 1, 1925.

Description.—Shape, massive to encrusting. Size, up to 3 cm thick, 10 cm in diameter. Consistency, firm, slightly compressible. Color in life, brilliant vermilion red; preserved, very pale drab. Oscules, rare; diameter, about 0.5 mm. Pores, not evident. Surface, superficially tuberculate, tubercles 1 to 2 mm high, crowded all over the surface.

Ectosomal specialization, vague or lacking, except for the dense stand of erect spicules. Endosomal structure, a dense isodictyal reticulation exactly of the *Myxilla* type, meshes often triangular, cells walled in with ranks of very spiny spicules. If one searches, one finds here and there a few smooth styles, points toward the surface. These may be regarded theoretically as vestiges of coring spicules of vanished ascending tracts, the echinating spicules of which have proliferated into ascendency. Our typical Myxillas may have similarly developed from fibroreticulate ancestors. Along the canals leading to the openings mentioned as probably oscular are regions packed with long smooth straight tylostyles. These same spicules stand upright about the apertures and are densely felted all over the surface, together with a few obviously foreign spicules. There is often a layer of the chelas between the tylostyle felt and

the acanthostyle reticulation. Some chelas and smooth tylostyles are mixed in with the spiny spicules of the parenchyma. Toxas occur in both places.

Principal spicules, acanthostyles to acanthostrongyles (fig. 59, *C*); size, 12μ by 120μ to 12μ by 140μ. These were interpreted in my earlier paper on this species as acanthotylotes, but further study shows the supposed tylote enlargement of the ends to be merely the somewhat greater spination at these points; actually this spicule is basically a style, and its pseudotylote shape is derived, I believe, from its attachment at both ends in connection with the very distinctive type of reticulation present. A few that project freely into canals are larger (up to 180μ) and obviously stylote. Ectoso-

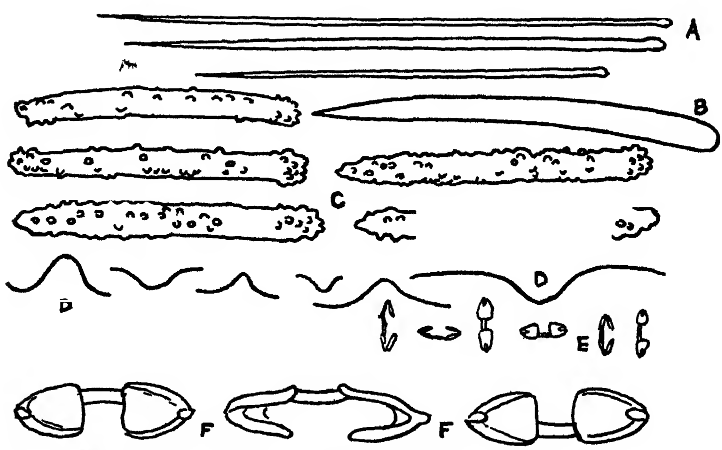

FIGURE 59.—*Isociona lithophoenix* (de Laubenfels): *E*, *F*, ×1,333; others; ×300

mal spicules, tylostyles (fig. 59, *A*); size, 3μ by 180μ to 4μ by 305μ. Third type of spicules, acanthostyles (not figured); size, about 12μ by 180μ. Fourth type of spicules, smooth styles (fig. 59, *B*); size, 9μ by 200μ to 14μ by 180μ, rare. First microscleres, palmate isochelas (fig. 59, *E*, *F*); length, 19μ to 24μ. Second microscleres, toxas (fig. 59, *D*); length, 23μ to 110μ.

Remarks.—The only other described species of *Isociona* is *tuberosa* Hentschel (1911, p. 326), which lacks the toxas and the rare smooth endosomal styles and has small (4μ by 90μ) endosomal spicules, less spiny than in *lithophoenix.* This West Australian sponge was dredged from 3 meters. Hentschel described it as *Lissodendoryx* with much hesitation, commenting that a new genus might be needed. In 1920 (p. 768), Hallmann discussed it further and erected *Isociona* for it. I agree heartily with Hallmann.

Family PLOCAMIIDAE Topsent

Genus PLOCAMIA O. Schmidt

PLOCAMIA KARYKINA de Laubenfels

Plocamia karykinos DE LAUBENFELS 1927, p. 262.

Holotype.—U.S.N.M. No. 21480; B.M. No. 29.8.22.35.

Type locality.—Pacific Grove, Calif., intertidal, July, 1925. The species is very abundant in central California but seems lacking in the southern part of the State.

Description.—Shape, encrusting. Size, up to 4 cm thick, spreading laterally indefinitely. The thickness is usually well under 1 cm. Consistency, firm, woody. Color in life, brilliant scarlet; preserved, drab. Oscules, sometimes with slightly raised collars; diameter 1 to 2 mm; about one to the square centimeter. Pores about 180μ in diameter when fully open; about one to the square millimeter. Surface, superficially hispid; level.

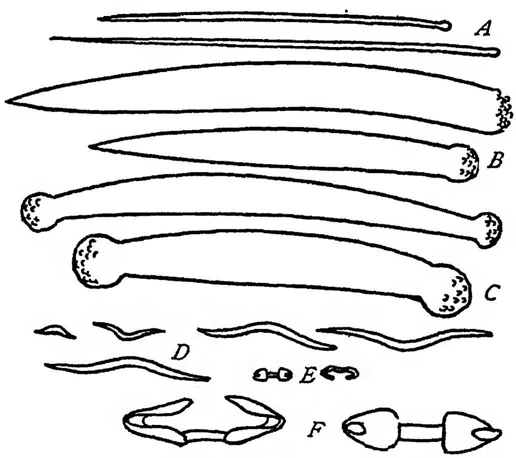

FIGURE 60.—*Plocamia karykina* de Laubenfels: Two spicules (*F*), ×1,333; others, ×300

Ectosomal specialization, vague or lacking. The tylostyles classed as interstitial are also found rather frequently at the surface. Endosomal structure, plumose ascending columns with ladderlike connectives. Ascending fibers, 50μ to 100μ in diameter, cored by subtylostyles. Accessory or transverse fibers consisting of single spicules only, the tylotes.

Principal spicules, subtylostyles with microspined heads (fig. 60, *B*); size, 18μ by 175μ to 22μ by 220μ. Secondary spicules, tylotes with microspined heads (fig. 60, *C*); size, 16μ by 210μ to 22μ by 175μ. Interstitial spicules, tylostyles (fig. 60, *A*); size, 2μ by 200μ to 3μ by 160μ; besides occurring interstitially these are almost common enough at the surface to be considered also as ectosomal. First microscleres, palmate isochelas (fig. 60, *E*, *F*); length, 10μ to 17μ. Second microscleres, toxas (fig. 60, *D*); length, 18μ to 80μ.

Remarks.—This species has a characteristic useful in field determination—upon injury, it emits copious quantities of a colorless slime not conspicuous before the injury.

As for the relationships of this species, I may quote my 1927 article (p. 263), as follows:

Its closest relatives are *P. manaarensis* Carter, 1880, from India, and *P. novizelanica* Ridley 1881, from New Zealand. Both of these, however, are *Gorgonia*-like in architecture, the former has an isodictyal structure, the latter has its tylotes entirely spined and both have very large smooth styles quite unlike any in our local form.

There is in the United States National Museum a small fragment of a sponge with no more definite locality record than from "The Coast of California," which Mr. L. M. Lambe identified as *P. manaarensis*. It certainly is not the Indian sponge, but there is not enough of it to be sure if it is *P. karykinos* or some other *Plocamia*.

PLOCAMIA IGZO, new species

Holotype.—U.S.N.M. No. 22058; B.M. 30.10.8.1.

Type locality.—Collected by me at Point Pinos, Calif., intertidal, July 11, 1930.

Description.—Shape, encrusting. Size, 9 mm thick. Consistency, stiff to fragile. Color in life, carmine-red. Oscules, not evident. Pores, very evident; 20μ to 25μ in diameter and only about 70μ to 75μ apart, center to center. The surface was minutely hispid, very lumpy.

Ectosomal specialization, a very intangible protoplasmic dermis, not separable; it contains abundant microscleres. Endosomal structure: There are rather meandering but in general ascending plumose tracts, containing perhaps a little spongin. The total diameter of each is about 200μ, and each is profusely echinated by smooth monaxons.

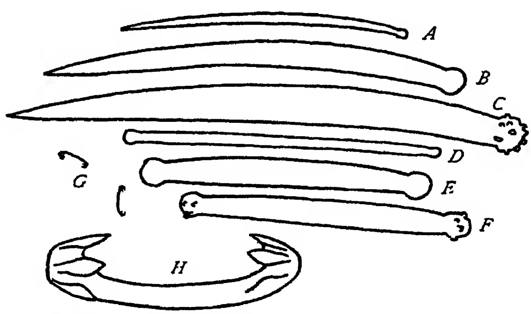

FIGURE 61.—*Plocamia igzo*, new species, ×300, except *H*, ×2,400

There are regions where the flesh contains practically no spicules except the microscleres. Principal spicules, tylostyles with heads often but apparently not always spined, the spines varying from coarse to exceedingly fine (fig. 61, *A–C*); the common range is from 11μ by 190μ to 35μ by 240μ. Some very thin ones are probably immature or undeveloped examples of this spicule sort. These spicules make up the bulk of the megascleres; namely, the plumose columns. Secondary spicules, tylotes, with heads varying from rather coarsely spined to very finely so, or not at all (fig. 61, *D–F*); the size range is commonly about 13μ by 130μ, but there are much thinner ones, pre-

sumably immature. These tylotes are chiefly interstitial but occur here and there in the plumose tracts. The microscleres are arcuate isochelas 14μ long (fig. 61, *G*, *H*).

Remarks.—The probability must be considered that this is a variation of *Plocamia karykina*, from the same locality, which has very similar megascleres and architecture. *P. karykina* shows no signs, however, of varying toward the characteristics of *igzo* in the respects wherein the latter differs from it. *P. igzo* is darker red than *karykina*, its chelas are very different in shape, approaching those for which Topsent (1927, p. 17) separated *denticulata* from *Plocamia* into his new genus *Plocamiancora*. *P. karykina* has few chelas and many toxas. It seems advisable, therefore, to regard *igzo*, at least provisionally, as a separate species.

The closest description to that of *Plocamia igzo* is that of *Plocamia plena* Sollas (1879, p. 44), which, however, differed in having small entirely acanthose styles in addition to the spicule sorts of *igzo*. It had toxas and isochelas that seem to have been either anchorate or arcuate (it can not be ascertained which from the figures or description). It was collected from deep water off the west coast of Africa.

Family ? (MICROCIONIDAE or DESMACIDONIDAE)

Genus OPHLITASPONGIA Bowerbank

OPHLITASPONGIA PENNATA (Lambe) CALIFORNIANA, new variety

Holotype.—U.S.N.M. No. 21475; B. M. No. 29.8.22.37.

Type locality—Pacific Grove, Calif., intertidal, July, 1925. This variety is very abundant in central California, where I have found it nearer high-tide mark than any other sponge; it seems always to be so placed as to avoid direct sunlight, however, shaded usually by seaweed.

Description.—Shape, encrusting. Size, up to 2.5 mm thick, spreading laterally indefinitely. Consistency, firm, slightly spongy. Color in life, scarlet; preserved, drab. Oscules, not peculiar as seen in life, but on drying or taking out of water each is seen to be in the center of a stellate figure of radiating grooves that is locally very distinctive; the size is about 0.6 mm in diameter. Pores, minute, abundant. Surface, superficially velvety.

Ectosomal specialization, vague or lacking. Endosomal structure, permeated by plumose tracts cored and echinated by smooth subtylostyles. At the surface these make extensive brushes or tufts. The echinating spicules often make a picture strongly suggestive of *Esperiopsis originalis* (which see, for further comparisons). Ascending fibers, 60μ to 90μ in diameter.

Principal spicules, subtylostyles (fig. 62, *A*); size, 17μ by 215μ to 22μ by 261μ. Microscleres, toxas (fig. 62, *C*); length, 45μ to 55μ. There are also rhaphides or very slender tylostyles (fig. 62, *B*); size, about 2μ by 140μ, which may be regarded as microscleres or as interstitial megascleres.

Remarks.—The original name for this species was *Desmacella pennata* Lambe (1894, p. 129), from Vancouver Island, about latitude 48° 20′ N., longitude 123° 40′ W. (holotype, now U.S.N.M. No. 7488). It had styles with microspined heads, total size from

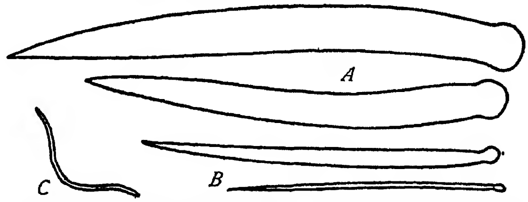

FIGURE 62.—*Ophlitaspongia pennata* (Lambe) *californiana*, new variety, ×300

16μ by 170μ to 19μ by 379μ, and toxas both more numerous and much larger (72μ to 255μ) than in the Californian form, which is therefore described here as a new variety.

Family ACARNIDAE Topsent

Genus ACARNUS J. E. Gray

ACARNUS ERITHACUS de Laubenfels

Acarnus erithacus DE LAUBENFELS 1927, p. 258.

Holotype.—U.S.N.M. No. 21430; B.M. No. 29.8.22.32.

Type locality.—Near Pacific Grove, Calif., intertidal.

Material examined.—Nine specimens, as follows:

1. Collected about 1850 from "California." Zoological Museum, Berlin.
2. No date nor data, except southern California. Univ. Southern California coll.
3. January 28, 1924, Santa Catalina Island, 36 meters, bottom temperature 15°. Univ. Southern California coll., U.S.N.M. No. 21416.
4. July, 1925, Pacific Grove; intertidal (holotype).
5. August 1, 1925, Whites Point (near San Pedro) (southern California); intertidal. Univ. Southern California coll., U.S.N.M. No. 21420.
6. July 25, 1926, Pescadero Point (central California); intertidal. U.S.N.M. No. 21431.
7. January 24, 1929, Carmel, Calif., intertidal.
8. March 30, 1929, Monterey Bay, 15 meters; trawled by Professor Skogsberg.
9. May 9, 1929, Monterey Bay, 700 meters; trawled by E. F. Ricketts. U.S.N.M. No. 21506.

Description.—Shape, encrusting to massive. Size, up to 5 cm thick, 10 mm in diameter. Consistency, firm, slightly compressible.

Color in life, brilliant scarlet; preserved, drab. Oscules, round, often with elevated, craterlike rims; diameter about 4 mm; distance apart 2 to 5 cm. Pores, abundant, minute, represented by the spaces between the distal ends of the ascending columns. Surface, superficially hispid.

Ectosomal specialization: There is an occasional patch of a very thin dermal membrane covering the larger spaces between the summits of the columns. Endosomal structure, characterized by conspicuous ascending tracts. Histological details: The flagellate chambers are subspherical and about 30μ to 40μ in diameter. Ascending fibers, 200μ to 350μ in diameter, nearly 1 mm apart.

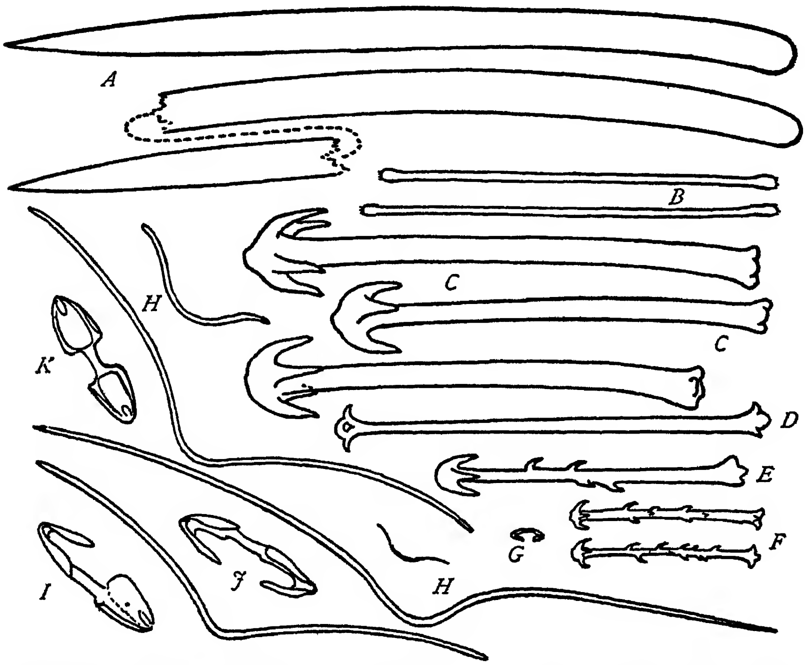

FIGURE 63.—*Acarnus erithacus* de Laubenfels: *I–K*, ×1,333; others, ×300. *E*, *D*, uncommon intermediates between *C* and *F*

Ectosomal spicules, tylotes with heads microspined (fig. 63, *B*); size, 3μ by 185μ to 4μ by 175μ. Interstitial spicules, cladotylotes (fig. 63, *C*); size, 11μ by 230μ, chords 35μ. Coring spicules, styles (fig. 63, *A*); size, 18μ by 345μ to 17μ by 425μ; these are the most conspicuous spicular element. Echinating spicules, acanthocladotylotes (fig. 63, *F*); size, 3μ by 80μ, chords 11μ and larger. First microscleres, palmate isochelas (fig. 63, *G*, *I–K*); length, 14μ to 16μ. Second microscleres, toxas (fig. 63, *H*); length, 40μ to 340μ.

Remarks.—The most conspicuous spicules are the smooth styles, which are grouped, points toward the surface, in ascending plumose tracts held together by a small quantity of nearly invisible spongin.

The chelas are quite commonplace, of the *Microciona* sort, and very abundant. The toxas are also often abundant and exhibit a most amazing variation in size, at least 40μ to 340μ, with all sizes in between of approximately equal abundance.

The so-termed dermal tylotes are more properly secondary or tangential connections between the ascending columns near the surface of the sponge. Their terminal spines, often *just four* in number, are nearly 2μ long but so very fine that they can not be clearly seen without oil immersion. Deeper in the sponge their place seems to be taken by the cladotylotes, which are only fastened at one end, so that they are also quite properly to be termed echinating spicules. In this species they are remarkable for their tetrasymmetrical plan, so that they become hexactinal spicules, superficially resembling the clavules of the proper hexactinellid sponges. The embedded end (encased in spongin) shows four hemispherical protrusions matching the four clads at the other end. Besides the larger, smooth-shafted "palm trees" (fig. 63, *C*) there are small curve-spined "rose stems" (fig. 63, *F*). Intermediates in size, with but a few spines, occur (fig. 63, *E*), but are rare.

Heated cladotylotes when studied with oil immersion do not show connection between the axial canals of the clads and that of the rhabd. Those of *Acarnus ternatus* have usually three clads, and were used by Dendy and Ridley (1886, p. 157) as a chief argument for the theory that monaxons were closely related to the tetraxons, but in tetraxon spicules (such as anatriaenes) the clads have their axial canals connected to that of the rhabd. In *Acarnus* these spicules seem to have been first tylote, with the clads added later. This is completely homologous with the ends of the rays of hexactinellid discohexasters (see Lendenfeld, 1915, pl. 9) and the ends of hexactinellid amphidisks (see Kirkpatrick, 1910). There is further homology between the hexactinellid amphidisks and those of such monaxonid genera as *Iotrochota* and *Ephydatia*. Monaxonid chelas are merely amphidisks with the central shaft displaced laterally until it has coalesced with teeth with which it has made contact. Spicules very strongly suggestive of hexactinellid relationship are to be found in such diverse monaxonid genera as *Acarnus*, *Axos*, *Cliothoosa*, *Dolichantha*, *Endectyon*, *Proteleia*, *Hymeraphia*, and *Raspailia*. Undoubtedly many seemingly monaxonid sponges, such as the epipolasids, are really reduced tetraxonids, but the majority are rather closer to the hexactinellids. Separate orders are indicated from monaxons and triaxons, but Dendy's Astrotetraxonida and Sigmatotetraxonida imply relationships not borne out by the evidence.

Acarnus erithacus shows a variability that will be discussed with reference to the list given above of the nine specimens studied. These display the following range of variation:

All were brilliant scarlet in life, as far as known, except No. 9, from very deep water. It was drab in life.

All had very similar consistency except No. 3. This consisted of several handfuls of separate sponges, all rather soft and compressible.

No. 7 was crowded with brilliant-red embryos about 150μ to 350μ in diameter. The tissue around them was somewhat paler than normal so that they showed distinctly.

Nos. 1, 7, and 8 lack the "palm tree" sort of spicule entirely. This is of great importance as to possible bearing upon value of spiculation in taxonomy, and this species will bear careful study in the years to come. It may be noted that Nos. 4, 5, 6, and 9 were known to be collected during summer months, and all had the "palm trees." Nos. 3, 7, and 8 were known to be collected during winter months, and of them only No. 3 had this sort of spicule, and it came from a water temperature that is decidedly high for the coast of California; furthermore it very definitely is not in breeding condition, and No. 7 certainly was, and No. 8 possibly so. Can it be that the "palm trees" are lost in connection with the breeding season and that the temperature has some connection with the time of reproduction? Pending much further investigation this is but surmise.

The great similarity between No. 9, from the very considerable depth of 700 meters, and the other specimens, from intertidal or very shallow water, is quite interesting. Linearly, the point of collection was but about 10 kilometers from the localities for Nos. 4 and 8.

Family RASPAILIIDAE Hentschel

Genus HEMECTYON Topsent

HEMECTYON HYLE de Laubenfels

Hemectyon hyle De Laubenfels, 1930, p. 28.

Holotype.—U.S.N.M. No. 21418; B.M. No. 29.9.30.4.

Type locality.—The one specimen was collected by the University of Southern California on February 16, 1924, at Point Fermin, near San Pedro, Calif.

Description.—Shape, frondose. Size, 28 mm high, 20 mm in diameter. Consistency, between spongy and cartilaginous. Color in alcohol, pale drab. Oscules and pores, not evident. Surface, superficially smooth.

Ectosomal specialization, a dermal membrane about 75μ thick; it contains scattered dark cells or foreign bodies. Endosomal structure, divided sharply in two portions, an axial region and a peripheral

zone. The axial region consists of much protoplasmic structure with smooth styles in confusion, showing perhaps a trace of reticulation; they are held together by small quantities of spongin. The peripheral zone is about 400μ thick and is a dense forest of peculiar acanthostyles, points out. These, as characteristic of this genus, have the basal third curved and smooth, the spines very large and recurved. Since most of the lamellate fronds are less than 2 mm in thickness, the axial portion averages only about 700μ thick.

Ectosomal or echinating spicules, acanthostyles (fig. 64, *A*, *B*); size, 12μ by 180μ to 20μ by 320μ. Interstitial spicules, smooth, ends so regularly broken that it is not certain what sort they were (fig. 64, *E*); size, 10μ by at least 800μ, rare, probably several millimeters long

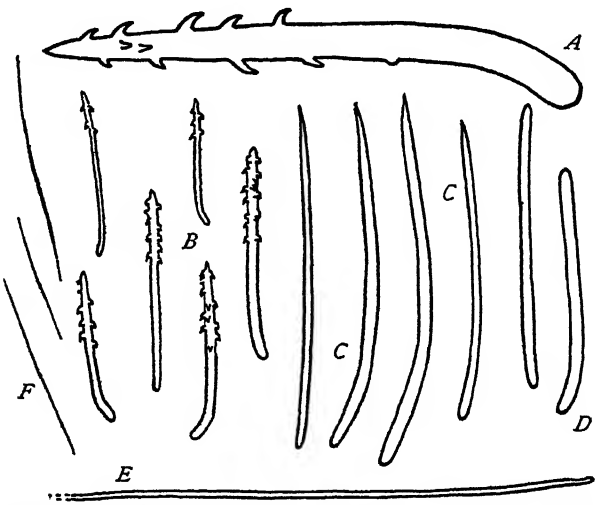

FIGURE 64.—*Hemectyon hyle* de Laubenfels: *A*, ×300; others, ×100. *E*, fraction of total length of spicule shown

when intact. Coring spicules, smooth styles (fig. 64, *C*); size, 15μ by 430μ to 20μ by 550μ; also smooth strongyles (fig. 64, *D*); size, 16μ by 350μ to 19μ by 370μ. Microscleres, oxeote rhaphides (fig. 64, *F*); size, 2μ by 200μ to 2μ by 330μ.

Remarks.—The nearest relative of this form is *Hemectyon hamata* Schmidt (1870, p. 62) from the West Indies. This, the only other member of the genus, was inaccurately described by Schmidt and put in the genus *Raspailia.* It is correctly redescribed by Topsent (1920, p. 26), who erected the genus *Hemectyon* for it. The species *hyle* clearly belongs in this genus, but it has many features of specific difference; *hamata* has a strongly reticulate axial region with much spongin. Its smooth styles are smaller, only 300μ to 350μ long. Its interstitial spicules are shorter than those of *hyle*, being only up to about 600μ. Its peripheral region had definite radiating fibers echinated by the acanthostyles; such fibers are lacking in *hyle*. Its

rhaphides were stylote, not oxeote as in *hyle*. The similarities are even more remarkable, however, especially the distinctive form of the acanthostyles and their peripheral localization, and the unusual axial core of styles in spongin.

Family ? (RASPAILIIDAE or EURYPONIDAE)

Genus CYAMON J. E. Gray

CYAMON NEON de Laubenfels

Cyamon neon DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21412; B. M. No. 29.9.30.5.

Type locality.—Between Point Dume and Newport (near San Pedro, Calif.), depth and date not stated.

Additional material examined.—Two specimens, like the holotype, collected by the University of Southern California, one (U.S.N.M. No. 21384) from south of San Pedro, depth 36 meters, September 24, 1924; the other from Point Fermin, near San Pedro, February 16, 1924.

Description.—Shape, massive. Size of largest specimen, 2 cm thick, 7 cm in diameter; the other two are much smaller. Consistency, spongy. Color in alcohol, dark brown. Oscules, not evident (see below under "Surface"). Pores, not evident. Surface, superficially a dermal membrane; this is fleshy, detachable, about 15μ thick and contains very abundant cells about 15μ diameter, having conspicuous very dark granules. There are no pores visible in it, it probably having contracted, thus obliterating them. Very few spicules are in it, and some of those, as for instance a few short (100μ) oxeas, are probably foreign. Endosomal structure, densely protoplasmic. In places there are spicules in confusion; again there are definite ascending fibers of spongin containing spicules as described below. Much rather coarse sand occurs throughout. Ascending fibers are 40μ to 50μ in diameter and about 150μ apart.

Interstitial spicules, styles (fig. 65, *D*); size, about 15μ by more than 1,700μ; these occur scattered in the flesh, usually with points perpendicular to the surface, and they project scatteringly from the surface of the sponge. Coring spicules (?), styles (fig. 65, *C*); size, about 35μ by 630μ; these are to be regarded as coring spicules only upon surmise, as they are quite rare, and I am not sure of their exact location in the sponge, but it seems they are in the very center of the spicule bundles of the fibers. Echinating spicules, triacts or tetracts (fig. 65, *A*, *B*); size of rays, about 15μ by 60μ to 20μ by 120μ. These are usually triacts, with two rays smooth and lying lengthways in the fiber, the third ray distally microspined and projecting from the fiber to echinate it. The ends are sometimes

strongylote and sometimes oxeote. Tetracts show in boiled-out preparations but are not readily found in sections.

Remarks.—*Cyamon* and *Trikentrion* are in a little group by themselves, very distinct from other sponges. Practically all the species of *Cyamon* hitherto described have had their distinctive (polyactine) spicules entirely and finely spined, the other spicules styles. In contrast, *Trikentrion* has its polyactine spicules usually triacts and with only one ray spined, but that coarsely so and with diactines as accompanying spicules. *C. neon* is a very distinct type, answering the definition of *Cyamon* but being very different from any of the genus. On paper it reads a bit like *Trikentrion flabelliformis* Hentschel (1912, p. 377), from the East Indies, but the illustrations

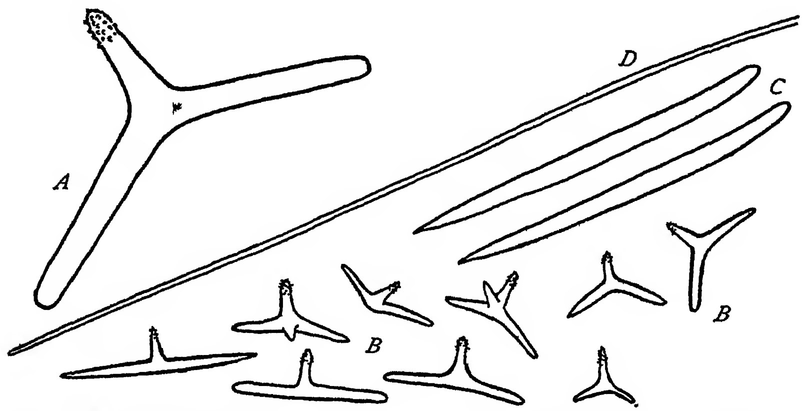

FIGURE 65.—*Cyamon neon* de Laubenfels *A*, ×300; others, ×80. *D*, fraction of total length of spicule shown

show great differences. The comparison is mentioned only because *flabelliformis* shows us a species with both monacts and diacts, with the polyactines mostly triacts and only one ray spined; these are coarse spines, however, and there are numerous differences in spicule size, and general architecture of the sponge.

Order HAPLOSCLERINA Topsent

Family SPONGILLIDAE Gray

Genus SPONGILLA Lamarck

SPONGILLA LACUSTRIS (Linnaeus)

Spongia lacustris LINNAEUS, 1759, p. 1348.
Spongilla lacustris LAMARCK, 1815.

Material examined.—U.S.N.M. No. 21516; B.M. Nos. 29.10.31.1, 29.9.30.3. These bright green digitate fresh-water sponges were collected by Prof. W. K. Fisher, of Stanford University, at Lake Tahoe, elevation 2,040 meters, August, 1925.

Description.—No gemmules could be found in this material, but the smooth oxeote principal spicules, about 11μ by 330μ, and spiny microxeas, about 6μ by 65μ, as well as all other characteristics, are those of the cosmopolitan and abundant *Spongilla lacustris.*

Remarks.—Gemmules are absolutely necessary for certain identification of most fresh-water sponges, but the probabilities are very great that this is *lacustris.*

Genus EPHYDATIA Lamouroux

EPHYDATIA ROBUSTA (Potts)

Meyenia robusta Potts, 1887, p. 225.
Ephydatia robusta Weltner, 1895, p. 127.

Occurrence.—Potts (1887) recorded this species from Honey Lake Valley near Susanville, Calif., in northeastern California, at an elevation of about 1,400 meters. Annandale (1907, p. 24), recorded it from Bhim Tal, Kumaon, northern India, at an elevation of 1,350 meters. These seem to be the only records for this species.

Genus CARTERIUS Petr

CARTERIUS TUBISPERMA (Potts)

Carterella tubisperma Potts, 1881, p. 150.
Carterius tubisperma Smith, 1921, p. 15.

Occurrence.—Smith (1921, p. 15), recorded a specimen of this species as being in the United States National Museum with locality listed as Fresno, Calif. It was collected by Gustav Eisen and determined by Potts (U.S.N.M. No. 5979). This species is probably cosmopolitan, there being numerous records from localities scattered over the Eastern United States and Europe. It was originally described without name by Mills (1880, p. 132).

Family HALICLONIDAE [7]

Genus GELLIUS J. E. Gray

GELLIUS EDAPHUS de Laubenfels

Gellius edaphus de Laubenfels, 1930, p. 28.

Holotype.—U.S.N.M. No. 21444; B.M. No. 29.8.22.17.

Type locality.—Pescadero Point, near Carmel, July, 1926; all my specimens have been removed from a mass at this point, readily identified as to location from year to year. There is every indication that it is the same sponge that remains there. Its placement is ecologically most interesting; it grows in a cavern at low tide, where sponges are extraordinarily abundant as covering the walls and ceilings; but it is the only one growing on the floor. It is just below low tide, hence never out of water. It is very unusual to find sponges

[7] For Haplosderidae Topsent. There is no sponge genus "*Haplosclera.*"

growing on a rocky coast where they could be stepped on without turning a rock.

Additional material examined.—A sponge in the collection of the University of Southern California, from Point Fermin, near San Pedro, Calif., intertidal, April 19, 1924.

Description.—Shape, massive. Size: The mass in the field was about 20 cm thick and 30 or 40 cm in diameter. Consistency, friable, almost stony hard. Color in life and when preserved, almost white. Oscules, round; diameter, about 1 mm; distance apart, about 8 mm. Pores, abundant, about 150μ in diameter. Surface, superficially smooth.

Ectosomal specialization, a dermal membrane; it is about 10μ thick, fleshy, not detachable, and contains some tangent spicules, but the special ectosomal reticulation so characteristic of this genus is not in evidence. Endosomal structure, densely packed with spicules in considerable confusion, with just an indication of basic isodictyal plan.

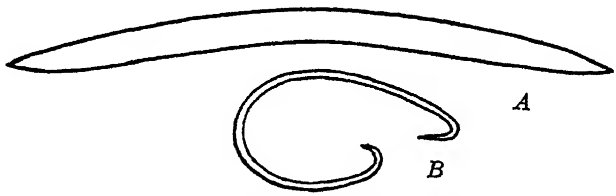

FIGURE 66.—*Gellius edaphus* de Laubenfels, ×300

Principal spicules, oxeas (fig. 66, *A*); size, 13μ by 260μ to 15μ by 270μ. Microscleres, sigmas (fig. 66, *B*); length, 30μ to 100μ.

Remarks.—The nearest relative of this form seems to be *Gellius centrangulatus* I. Sollas, 1902, from the East Indies, which differs in having very renierid structure and even smaller spicules. Most species of *Gellius* have much larger spicules than *edaphus*. *G. imperialis* Dendy, 1924, has spicules about the size of those of *edaphus* but has a very furrowed surface and structure with conspicuous tracts. Most species of *Gellius*, however, are separated by very narrow margins, and a reviewer with abundant material might be able to carry out extensive synonymy. This might even be regarded in common with perhaps a score of others as being within the range of variation of *Gellius flagellifer*.

GELLIUS TEXTAPATINA de Laubenfels

Gellius textapatina DE LAUBENFELS, 1926, p. 567.

Holotype.—U.S.N.M. No. 21446; B.M. No. 28.11.6.5.

Type locality.—The one specimen was in the small collection of Stanford University, date of collection unknown, locality Monterey Bay, Calif.; estimated depth, 720 meters.

Description.—Shape, concavo-convex lamellate. Size, 1 cm thick, about 12 cm in diameter. Consistency, fragile. Color in alcohol, very pale drab. Oscules (on the concave side only), diameter 0.7 to 1.2 mm; distance apart, about 6 mm. There is a very thin (10μ?) transparent membrane over the entire oscular surface, except for the openings of the oscules themselves, and it even closes them partially, in a sphinctrate manner. Pores, apparently only on the convex side. The above-mentioned dermis also covers the porous surface. The meshes of the skeleton are 0.7 to 1.1 mm in diameter, but the round apertures in the dermis, which may be considered the real pores, are but 100μ to 200μ. Surface, superficially smooth.

Ectosomal specialization, an optically evident reticulation of large spicules; the polygonal meshes are 0.5 to 0.8 mm in diameter. This dermal skeleton is about 0.2 mm thick. Endosomal structure, in places a typical renierid isodictyal reticulation with spongin nodes, elsewhere confused and vague. Most of the microscleres are endo-

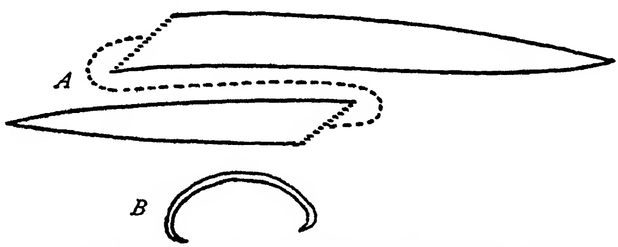

FIGURE 67.—*Gellius textapatina* de Laubenfels, ×300

somal. Histological details: There are spherical flagellate chambers of very great variation in size, namely, from about 30μ to 60μ in diameter. There are also fairly numerous embryos, about 350μ in diameter, grouped principally about the canals in the deeper portions of the endosome. A few of them have fairly numerous full-sized sigmas and minute straight rhabds in their peripheral region.

Principal spicules, oxeas (fig. 67, *A*); size, 20μ by 340μ to 22μ by 460μ. Microscleres, sigmas (fig. 67, *B*); length, 50μ to 80μ.

Remarks.—The almost complete lack of microscleres in the ectosome is remarkable. Both megascleres and microscleres are large as compared to most species in the genus.

HALICHOCLONA, new genus

The genus may be briefly characterized by comparison. It has the endosome of *Haliclona* (isodictyal reticulation of oxeas) plus the ectosome of *Halichondria* (detachable, with a definite dermal skeleton of tangential spicules). It may also be described as *Gellius* without the sigmas. Genotype, *Halichoclona gellindra*, new species.

HALICHOCLONA GELLINDRA, new species

Holotype.—U.S.N.M. No. 22063; B.M. No. 30.10.8.6.

Type locality.—The holotype was collected by me at Carmel, Calif., intertidal, on July 27, 1930.

Additional material studied.—At Laguna Beach, on March 14, 1926, I took a somewhat similar specimen with larger spicules, but in very poor condition for study, as it was growing over the macerated remains of a textraxonid sponge of radiate structure. This specimen was designated *Gellius* (?) *epocheomaius* in de Laubenfels (1930, p. 28). It was so difficult to allocate, even generically, that it could scarcely be regarded as a synonym of *H. gellindra*, but it is not worth treating as a separate species because of its similarity to *gellindra*.

Description.—Shape, encrusting. Size, 2 to 4 mm thick, somewhat more than 4 cm^2 in area. Consistency, fragile. Color in life, pale lavender. Oscules, few and irregular in shape, about 1 mm in diameter, often with raised collars nearly 1 mm high. Pores, abundant, 30μ to 50μ in diameter. Surface, superficially smooth.

Ectosomal specialization, a crust of tangentially placed oxeas, its thickness being only about 20μ. It is much like the ectosome of the genus *Gellius*, and also like that of *Halichondria panicea*; it is possible to remove it in flakes with moderate ease. Endosomal structure, oxeas in very regular isodictyal reticulation, united (by spongin?) at their apices only. This is much like *Gellius* and *Haliclona*.

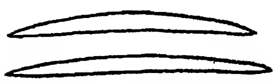

FIGURE 68.—*Halichoclona gellindra*, new species, $\times 300$

Principal spicules, oxeas (fig. 68); size, 3μ by 110μ to 4μ by 120μ, but the vast majority are very near to the latter size. The specimen from Laguna Beach had spicules 8μ by 150μ to 10μ by 170μ.

Remarks.—*Haliclona* is characterized by spicules of rather uniform size and by its reticulate endosome without trace of special tangential dermal skeleton.

Halichondria is characterized by its spiculation of most varied lengths and by its confused endosomal structure with very distinct tangential dermal skeleton.

Gellius has the same sort of isodictyal endosome as that of *Haliclona*, with the special ectosome resembling *Halichondria*, but has microscleres, namely, sigmas.

Halichoclona is compared to these three genera, but of the three, the most closely related in my judgment is *Gellius*. When I found the Laguna Beach specimen aforementioned, I considered it a *Gellius* that had lost its microscleres, it being in rather poor condition if not actually dead, before collection. It also might have been

altered by its growth within the surface of the macerated tetraxon sponge. The specimen from central California was alive and in excellent condition, however. All our local *Gellius* species have spicules very much larger than either of the specimens above referred to the new genus *Halichoclona.*

We may eventually merge all genera that are alike except for differences in microscleres, though there are practical reasons for depreciating such amalgamation. For the present there seems good reason for retaining this as distinct from *Gellius.*

XESTOSPONGIA, new genus

This genus is characterized by having only oxeas as spicules and these so abundant that any reticulate arrangement is obscured; there is no special dermal skeleton. Genotype, *Xestospongia diprosopia.*

XESTOSPONGIA DIPROSOPIA (de Laubenfels)

Haliclona diprosopia DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21509; B.M. No. 29.8.22.59.

Type locality.—The one specimen was collected in Monterey Bay, Calif., depth about 500 meters, by E. F. Ricketts.

Description.—Shape, lamellate. Size, 1 to 4 cm thick, 6 by 12 cm in area. Consistency, friable. Color dry, very pale drab. Oscules, on one side only; diameter, 3 mm; distance apart, 15 mm; over very shallow cloacas that branch almost at once into about a dozen diverticules. Pores, at least 100μ in diameter; principally on the nonoscular face. Surface, superficially smooth, with low rounded protuberances 5 to 15 mm high on the oscular surface.

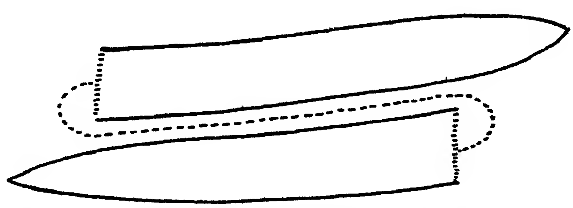

FIGURE 69.—*Xestospongia diprosopia* (de Laubenfels), ×300

Ectosomal specialization, lacking, although there is a false appearance as of a special ectosomal reticulation, because of the fact that the endosomal reticulation is finer above and coarser below. Endosomal structure, reticulate, with polygonal meshes about 0.5 to 0.7 mm in diameter, bounded by fascicular bundles of spicules. The spicule size is notably uniform.

Principal spicules, oxeas (fig. 69); size, about 30μ by 400μ.

Remarks.—This specimen was collected from the same general locality as *Gellius textapatina* and *Poecillastia rickettsi* and is note-

worthy for external simulation of these two sponges. We must conclude that the remarkable structure is in a large part an ecological adaptation. This should not be interpreted that this is some common shallow-water sponge that has lightly assumed such shape because of its surroundings, but that this species has by selection or some other determiner come to have this structure. It is remarkable further in that it is the slightly convex side that is oscular; usually in concavo-convex sponges the reverse is true. This very unusual circumstance is also reported for *Xestospongia* (*Petrosia*) *coralloides* Dendy (1924, p. 325). It may be a generic tendency. *X. diprosopia* is remarkable for this character, which it shares with *coralloides*, and for the large size of its spicules, by which it may be distinguished from that species and most others.

XESTOSPONGIA VANILLA (de Laubenfels)

Haliclona vanilla DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21452; B.M. No. 29.8.22.45.

Type locality.—Pacific Grove, Calif., July, 1925, collected by me. This is one of the most abundant sponges in central California, occurring usually on the under side of bowlders in the lower half of the intertidal zone.

Description.—Shape, encrusting. Size, up to 1 cm thick, spreading laterally indefinitely. Consistency, stony hard. Color in life and when preserved, white or very pale yellowish drab. Oscules, round, often with raised rim, diameter 1 to 1.5 mm, distance apart about 1 cm. Pores, approximately 100μ in diameter. Surface, superficially smooth.

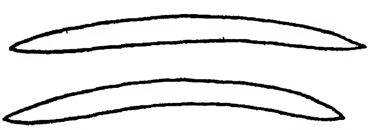

FIGURE 70.—*Xestospongia vanilla* (de Laubenfels), ×300

Ectosomal specialization, vague or lacking. Endosomal structure, a reticulation of canals in a ground substance in which the spicules are so densely packed that no pattern can be discerned in their arrangement. The canals, however, are usually either perpendicular or parallel to the surface and often meet at right angles, so that they make a symmetrical pattern.

Principal spicules, oxeas (fig. 70); size, 11μ by 150μ to 12μ by 160μ.

Remarks.—*Petrosia* was erected by Vosmaer (1885, p. 338) for *Reniera dura* of Schmidt (1862, p. 76), to replace *Schmidtia* of Balsamo Crivelli; that name being preempted. He lists various forms and specifies stony consistency, spicules crowded together, oxeas, strongyles, and rarely styles. Ridley and Dendy (1887, p. 9), define *Petrosia* thus:

> Sponge usually hard or even stony; generally with numerous, well-defined large oscula. Skeleton more or less confused; spicules oxeote to strongylote,

usually short and thick, packed close together in tracts. The most obvious feature of this genus is its hard, often stony texture.

It would seem that two distinct generic types are included in the sponges assigned to the above diagnosis. One group typically has large thick strongyles, plus large thick oxeas plus very small spicules apparently representing a distinct category, because they are found of considerable diameter although short. The spicules that seem clearly to be immature are nearly as long as, though much thinner than, the type they are approaching by their growth. The ectosome seems unknown for the genotype, but most of the species having the above characteristics, as for example *Petrosia lignosa* Wilson (1925, p. 403), have special dermal tangential skeletons. A second group lacks this ectosmal specialization and therefore may be taken as worthy of generic separation; a further parallelism seems to be that this group has only oxeote spicules. I would suggest that the group exemplified by *Petrosia lignosa* and probably by the genotype, *P. dura*, is most closely related to *Gellius* and *Strongylophora* (and possibly even to *Halichondria* ?), while the second group is most closely related to *Haliclona*. The second group comprises several sponges described by Dendy, for example *Petrosia densissima* (1905, p. 145) and *coralloides* (1924, p. 324), and perhaps several other species, such as *P. variabilis* Ridley (1884, p. 415), *P. similis* Ridley and Dendy (1886, p. 327), and *P. fistulata* Kirkpatrick (1907, p. 290). Most of the earlier authors and some of the later ones fail to give adequate data concerning surface structure. The new generic name *Xestospongia* is proposed for this latter group.

Genus HALICLONA Grant

HALICLONA ECBASIS de Laubenfels

Haliclona ecbasis DE LAUBENFELS, 1930, p 28.

Holotype.—U.S.N.M. No. 21449; paratype, B.M. No. 29.8.22.48.

Type locality.—From the floating dock of the Yacht Club in San Diego Bay, Calif., collected by Prof. C. M. Child.

Additional material examined.—I have found the same species growing abundantly on the floating dock of the Yacht Club at Wilmington (near San Pedro). On March 4, 1926, I found small bits of an encrusting sponge, intertidal, at Laguna Beach, which may be of the same species.

Description.—Shape, ramose or digitate, often with an axial hollow about one-third the diameter of the branch. Size, up to 10 cm high, about 1 cm in diameter. Consistency, spongy. Color in life: Prof. C. M. Child, writing of his specimen, collected during the summer, says: " The color in life is purple, apparently becoming brown later

in the season." My specimens doubtfully referred to this species (collected intertidally in March), were bluish lavender. My specimens clearly of this species, collected from a similar situation to that of the holotype but in April, were drab.

Oscules, few, apical, diameter 2 to 5 mm. Pores: There are openings over the entire surface very irregular in size and shape, varying at least from 60μ to 200μ in diameter. Surface, superficially hirsute, on account of projecting fiber ends nearly 1 mm high.

Ectosomal specialization, vague or lacking. Endosomal structure, a fibrous reticulation with polygonal meshes about 75μ in diameter. There is a groundwork of spicules in confusion amid the protoplasmic structures. Ascending fibers 10μ to 20μ in diameter, cored by 4 to 7 rows of spicules. Accessory or transverse fibers 10μ to 20μ in diameter, cored by 4 to 7 rows of spicules.

Principal spicules, oxeas (fig. 71); size, usually about 5μ by 100μ; a few much thinner ones are probably developmental stages.

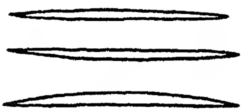

FIGURE 71.—*Haliclona ecbasis* de Laubenfels, ×300

Remarks.—Linnaeus (1759) lists a *Spongia oculata* that may well be the same species as that which Bowerbank in 1862 (p. 1126) made the type of his genus *Chalina*, namely *C. oculata*. This is a very common British sponge. Oddly enough Bowerbank accredited the genus to Grant, though I can find no mention of the name in Grant's writings. In 1841 (p. 5), however, Grant erected a genus *Haliclona* for a species that he called *occulata*, obviously a misspelling of *oculata*. His figure is an excellent representation of the common *oculata*. This seems to be the first generic name other than Linnaeus's all-inclusive *Spongia* to be applied to this species, and it appears to have been mere oversight on the part of the early spongologists that it has not been in use ever since. Grant's *Halina*, a *nomen nudem*, has little or no bearing here.

Against employment of *Haliclona* it may be argued that the original description could have included *Acervochalina limbata*, or even *Isodictya palmata*. It must be admitted that Grant would probably have diagnosed either of these as *Haliclona*. There is no doubt, however, that the well-known *oculata* was included, and there is grave question whether Grant had any specimens of the rarer species resembling it. Grant's genus *Cliona*, as he described it, might well have included *Thoosa*, yet we should hardly drop it for that reason. It seems quite as logical to employ *Haliclona* as to use *Cliona*.

As compared to the type of *oculata*, *ecbasis* averages more spicules to the fiber, and fiber less kinky. As compared to the type of *limbata* (made type species of the genus *Acervochalina* Ridley, 1884), *ecbasis* averages finer mesh, has less visible spongin, yet seems

tougher. Conditions of preservation may be the cause of this difference. As compared to the type of *simulans* (made type species of the genus *Adocia* Gray, 1867, p. 522), the fibers of *ecbasis* stand out more conspicuously from the other tissues, and it has smaller spicules. No comparison can be made to *Pachychalina* Schmidt (1868, p. 8), which is little more than a name; its type species, *P. rustica*, is represented by no specimens, and from its very brief description it may have belonged to any of many different genera.

As for the matter of few as contrasted to many rows of spicules in the fiber, while some species of *Haliclona* have definite tendencies one way or the other, the type species regularly exhibits, within a single specimen, portions that have the isodictyal reticulation characteristic of so-called *Reniera*, and portions of fiber having the many rows of spicules, which supposedly determine the group *Pachychalina*.

HALICLONA ENAMELA de Laubenfels

Haliclona enamela DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21450; B.M. No. 29.8.22.8.

Type locality.—Laguna Beach, intertidal, collected by me. On numerous other occasions I have seen sponges in the field that I feel confident were of this species, but in most cases I have been unable to detach specimens without injuring them excessively. The species is very thin, grows on hard rocks of great irregularity of surface, and is so firmly attached that utmost care is required to obtain fragments large enough to work with.

Description.—Shape, encrusting. Size, 1 to 2 mm thick, spreading laterally indefinitely. Consistency, spongy. Color in life and when preserved, drab. Oscules, with raised collars, diameter 1 to 1.5 mm, distance apart about 1 cm. Pores, very minute. Surface, superficially smooth to verrucose.

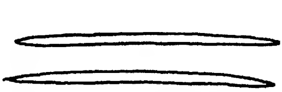

FIGURE 72.—*Haliclona enamela* de Laubenfels, ×300

Ectosomal specialization, vague or lacking. Endosomal structure, a fibrous reticulation, meshes rectangular and 75μ to 125μ in diameter; the plan is very symmetrical, though numerous spicules not in the fibers but strewn in confusion among them tend somewhat to obscure the regularity of arrangement. Ascending fibers, 15μ to 25μ in diameter, cored by 6 to 8 rows of spicules; the spongin is very pale. Accessory or transverse fibers, 5μ to 10μ in diameter, cored by 1 to 2 rows of spicules.

Principal spicules, oxeas (fig. 72); size, about 4μ by 120μ

Remarks.—Were one to use the diagnoses affixed to the names *Reniera*, *Chalina*, and *Pachychalina*, placing this sponge would be difficult. Thin crusting was supposedly characteristic of *Reniera*,

while the architecture of *enamela* is microscopically that of *Pachychalina* and *Chalina*, which were supposed to be usually ramose forms. Although moderately close to every one of the numerous species of *Haliclona*, I find no one species to single out as closest to *enamela*.

HALICLONA LUNISIMILIS de Laubenfels

Haliclona lunisimilis DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21451; B.M. No. 29.8.22.34.

Type locality.—Pacific Grove, Calif., intertidal, July, 1925, collected by me.

Additional material examined.—Two specimens taken at Laguna Beach, October, 1925. The species is moderately common in central California. So far, all the specimens I have found were growing on and around coralline algae near low tide.

Description.—Shape, massive, subspherical, attached only to coralline algae. Size, up to 2 by 3 by 5 cm. Consistency, toughly spongy, yet easily damaged. Color in life and when preserved, very pale drab. Oscules, craterlike, with raised rims; diameter about 4 mm; distance apart, more than 1 cm. Pores, 20μ to 60μ in diameter. Surface, superficially smooth.

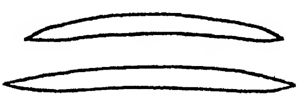

FIGURE 73.—*Haliclona lunisimilis* de Laubenfels, ×300

Ectosomal specialization, vague or lacking. Endosomal structure; there is a groundwork that is a very fragile, typically renierid isodictyal reticulation. Throughout this there is a course reticulation of tough spongin fibers about 75μ in diameter, crowded with many rows of spicules in typical pachychaline fashion. This species admirably shows the impossibility of separating genera upon these characteristics, which are, however, of supplementary value in species descriptions. This particular species may be characterized as one fitting the diagnoses of the old genus *Reniera* and the so-called *Pachychalina*.

Ascending fibers 70μ to 100μ in diameter, cored by many rows of spicules. Accessory or transverse fibers 70μ to 100μ in diameter, cored by many rows of spicules.

Principal spicules, oxeas (fig. 73); size, 8μ by 110μ to 10μ by 125μ.

Remarks.—This seems a well-marked species, though numerous sponges described as *Reniera* and as *Pachychalina* resemble it more or less. See notes given above in the description of the endosome.

HALICLONA CINEREA (Grant)

Spongia cinerea GRANT, 1827, p. 204.
Halichondria cinerea FLEMING, 1828, p. 521.
Isodictya cinerea BOWERBANK, 1866, p. 274.
Reniera cinerea SCHMIDT, 1870, p. 77.

Holotype.—Probably in the British Museum of Natural History.

Type locality.—Europe.

Material examined.—This species is at times abundant intertidally in central California; at other times rare. In the summer of 1925 it was most conspicuous, a year later it was rare, in the winter of 1929 a few specimens were seen, late in the spring none could be found. In southern California, at Laguna Beach, on March 14, 1926, I found a few little nubbins of a sponge agreeing in spiculation and structure with *cinerea* and probably of the same species, but brownish instead of the lavender color usually so regular on this coast.

Description (U.S.N.M. No. 21448; B.M. Nos. 28.11.6.1; 28.11.6.2).—Shape, encrusting. Size, up to 3 cm thick, 6 cm in diameter. Consistency, softly fragile. Color in life, lavender; occasional drab specimens are probably pathological. Preserved, drab. Oscules, conspicuous, with raised, craterlike rims; diameter, 2 to 5 mm; distance apart, usually a little more than 1 cm; see notes under "Surface." Surface, superficially very porous, crowded with depressions about 200μ in diameter; all or many of these probably represent actual pores.

FIGURE 71.—*Haliclona cinera* (Grant), ×300

Ectosomal specialization, inconspicuous; there are traces of a diaphanous, fleshy, nondetachable dermal membrane. Endosomal structure, a pronounced isodictyal reticulation with a few vague spicular tracts.

Principal spicules, oxeas (fig. 74); size, 6μ by 150μ to 8μ by 150μ.

Remarks.—In almost all parts of the world where sponges have been studied are found species that lack characteristics that would separate them from *cinerea*, so this is said to be a cosmopolitan species.

Order DICTYOCERATINA Minchin

Family SPONGIIDAE Gray

Genus SPONGIA ? ? ?

SPONGIA IDIA, new species

Holotype.—U.S.N.M. No. 22059; B.M. 30.10.8.2.

Type locality.—The specimen was collected by me intertidally at Point Lobos, south of Carmel, Calif., July 12, 1930. It was growing in a cave that was uncovered only at very low tide, and that was abundantly lined with sponges.

Description.—Shape, massive. Size, 4 by 7 by 12 cm. Consistency, spongy. Color in life, slaty ectosome over drab ectosome. As collected the sponge appeared lipstomous on account of the closure of apertures, and even in the aquarium the sphincters did not relax. It would seem that both pores and oscules must be less than 100μ when open. Surface, profusely conulose, the conules less than 1 mm high and about 1 mm apart, apex to apex. Ectosomal specialization, an organic dermis not readily detachable, opaque and melanistic; this from 300μ to 700μ thick. Endosomal structure, a flesh packed with spheroidal flagellate chambers about 25μ to 30μ in diameter, and also containing rather numerous evenly distributed foreign spicules and fragments of spicules, a little sand, and other débris. The skeleton is a reticulation chiefly of solid secondary fibers 60μ to 200μ in diameter. The spongin is rather granular-surfaced and medium dark brown, very like that in the commercial sponges. The fibers are often contorted, but the meshes are usually rectangular, about 200μ to 500μ in diameter. Here and there through the reticulation are principal fibers ascending perpendicularly to the surface. These are recognizable by having slight, scattered content of coring spicule fragments, but more so by somewhat fasciculated or fenestrated architecture.

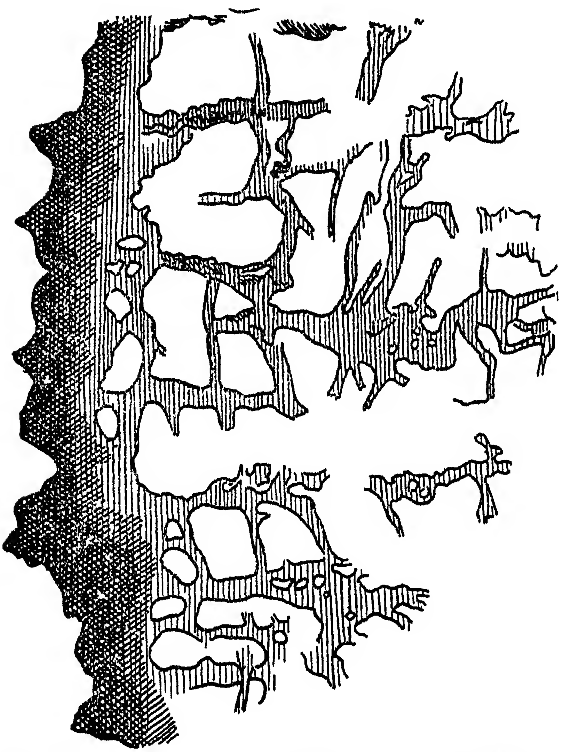

FIGURE 75.—*Spongia idia*, new species, ×18, drawn from a section taken perpendicular to the surface. Only the fiber and dermis are drawn, the flesh and foreign intrusions being omitted because their inclusion would obscure the structures to be illustrated

Remarks.—With some hesitation this species is here described in the genus *Spongia*, from typical members of which it differs sharply by having semifasciculated principal fibers. It agrees closely with *Spongia* in most or all other points, and this genus may well be employed pending revision of the horny sponges.

Family DYSIDEIDAE [8]

Genus DYSIDEA Johnston

DYSIDEA AMBLIA de Laubenfels

Duseideia amblia DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21424; B.M. No. 29.9.30.8.

Type locality.—"Long Wharf," Santa Monica, collected by the University of Southern California, July 18, 1914.

Additional material examined.—On February 25, 1926, following a severe storm, I found enormous quantities of this species cast up at Venice, southern California. This is only about 8 or 10 kilometers from the type locality. On the following day immense quantities of it were reported, with specimens brought me for identification, from near Ventura, about 90 kilometers from the type locality. I found no other species of sponge in the wrack with this one, but it must have been tremendously abundant, as bushels could have been collected. In all the dredging and other collecting of the University of Southern California, however, they seem to have taken but one fresh specimen. In July, 1930, I collected a massive specimen, intertidally, at Point Lobos, south of Carmel, Calif. It is certainly a *Dysidea* and probably conspecific with the southern specimens, though differing in shape and having all its fibers more loaded with coarse sand grains.

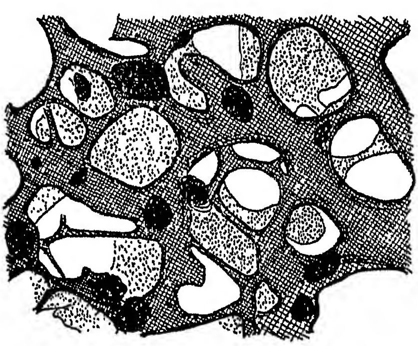

FIGURE 76.—*Dysidea amblia* de Laubenfels, ×40, a characteristic bit of the structure of this species

Description.—Shape, digitate, somewhat ramose. Size, up to 20 or 30 cm in height, about 1 cm in diameter. Consistency, spongy. Color in alcohol, drab. Oscules, inconspicuous, barely 100μ in diameter. Pores, not evident. Surface, superficially conulose with conules usually less than 1 mm high and less than 1 mm apart.

Ectosomal specialization, a very thin dermis, not detachable. Endosomal structure, a fibrous reticulation with meshes about 250μ in diameter. Principal, or ascending, fibers 100μ to 200μ in diameter, cored, sometimes superabundantly, by scattered sand grains often more than 100μ in diameter. Accessory or transverse fibers 10μ to 25μ in diameter, often uncommon, usually free from inclusions. The flagellate chambers are conspicuous, crowded together, and about 45μ to 55μ in diameter.

[8] For Spongeliidae Lendenfeld, because *Dysidea* supplants *Spongelia*.

Remarks.—This genus has often been called *Spongelia*, but *Spongelia* of Nardo, 1834, is a *nomen nudum*. It is first described by Johnston (1842, p. 185) as *Duseideia* or (preferably) *Dysidea*. The genus falls rather sharply into two divisions, fine-surfaced grays and coarse-surfaced purples. The first includes the genotype, *D. fragilis* Montagu. The second includes *pallescens* Schmidt, the genotype of *Spongelia* according to Vosmaer (1885, p. 363), and this might be retained as a separate genus, though the affinities are so close this seems to me inadvisable. Our Californian form is very close to *fragilis*, but differs in rather smaller fiber, which is also more sparsely cored, and by the frequency with which the principal fibers are horizontal as well as vertical.

Family VERONGIIDAE [9]

Genus VERONGIA Bowerbank

VERONGIA THIONA de Laubenfels

Verongia thiona DE LAUBENFELS, 1930, p. 28.

Holotype.—U.S.N.M. No. 21500; B.M. No. 29.8.22.31.

Type locality.—Laguna Beach, Calif., intertidal, March 14, 1926, abundant.

Description.—Shape, encrusting. Size, up to 4 cm thick, 12 cm in diameter. Consistency, spongy. Color in life, lemon yellow with greenish tints; in alcohol very dark purple. Oscules, few and scattered; diameter 2 to 7 mm. Pores, not evident, evidently very contractile. Surface, superficially smooth with conules 0.5 mm high, irregularly scattered.

Ectosomal specialization, a cellular dermis about 7μ thick. Endosomal structure, as typical for this genus, of the general consistency of a rather stiff jelly, permeated by meandering canals (about 1 mm in diameter) and by rather scattered fibers in reticulation. These fibers are clear yellow, with a core often apparently empty, again filled with opaque substance. In this species the thickness of the peripheral portion seems much more constant than the size of the pith, which is larger in the larger fibers, smaller in the smaller. The mesh is so very irregular in outline that it is very difficult to assign it measurements, but one is safe in saying that the mesh size averages more than 1 mm.

Histological details: The flagellate chambers are spheroidal, 25μ in diameter. Principal fibers 80μ to 150μ in diameter, cored by the usual pith as found in this genus. Pith of the fibers, 50μ to 110μ in diameter. (Fig. 77.)

[9] For Aplysinidae Schulze, because *Verongia* supplants *Aplysina*

Remarks.—All or nearly all the species of *Verongia* are very near the genotype, *V. fistularis* Lamarck, 1815, and can only be separated by little differences that may well be insignificant. If the accepted criteria be used, however, this form approaches in size of mesh, size of fiber, and size of pith only one other species of this genus, that described as *Aplysina procumbens* Lendenfeld (1889, p. 416), from New Zealand. That is also an encrusting form, but it is described with black fibers, a very great difference. Incidentally, it is very briefly and inadequately described.

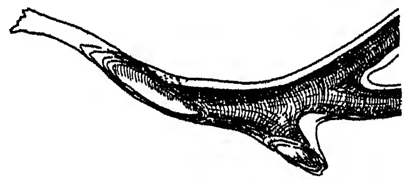

FIGURE 77.—*Verongia thiona* de Laubenfels, ×40; typical fiber cut obliquely at one point to show the lamellate, pithed structure

Verongia thiona is moderately common, at times at least, in the intertidal areas of southern California. I know of no other local form from which it may not easily be distinguished by its tendency (very common in this genus) to change from yellow to very dark blue or purple upon drying.

Order DENDROCERATINA Minchin

Family DARWINELLIDAE Merejkowsky

Genus APLYSILLA F. E. Schulze

APLYSILLA GLACIALIS (Dybowski)

Simplicella glacialis DYBOWSKI, 1880, p. 65.
Aplysilla glacialis LENDENFELD, 1889, p. 706.

Holotype.—Location unknown.

Type locality.—Arctic (White Sea).

Material examined.—Numerous specimens, all collected intertidally at Pacific Grove, Calif., in which vicinity the species is rather common. It occurs on granite bowlders fairly high up in the intertidal zone, seeming to be a very hardy sponge.

Description (U.S.N.M. No. 21432; B.M. No. 29.8.22.23).—Shape, encrusting. Size, 1 to 2 mm thick, 5 to 6 cm in diameter. Consistency, weakly spongy. Color in life, colorless to rosy red; in alcohol, drab. Oscules, round and scattered; about 1 mm in diameter. Pores, not evident. Surface, superficially glabrous, with conules about 1 to 2 mm high and 2 to 3 mm apart.

Ectosomal specialization, a dermis about 8μ thick, fleshy, and rather slimy. Endosomal structure, a rather dense mass of flagellate chambers and other protoplasmic structures permeated by canals and dendritic fibers. Histological details: The flagellate chambers

are eurypyllous, often polygonal in section, and typically about 30μ by 50μ by 70μ in size. Principal fibers, 80μ to 255μ in diameter, obviously of concentric layers. A pith often occupies as much as 80 per cent of the total, especially near the base of the sponge. These fibers arise from a basal plate (very thin) and branch a few times, but I find no anastomoses. The distal ends of the fibers cause the conules. (Fig. 78.)

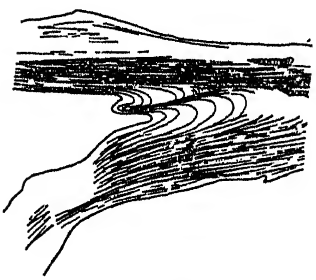

FIGURE 78.—*Aplysilla glacialis* (Dybowksi): Fiber, ×40

Remarks.—It is quite remarkable that the Californian specimens agree so closely with the original specimen from north of Europe, and with Lendenfeld's description of what he records as the same species from Australia.

APLYSILLA POLYRAPHIS de Laubenfels

Aplysilla polyraphis DE LAUBENFELS, 1930, p. 29.

Holotype.—U.S.N.M. No. 21434; B.M. No. 29.8.22.41.

Type locality.—The one specimen, or group of specimens, is from my personal collection, taken at Pacific Grove, Calif., July, 1925.

Description.—Shape, encrusting. Size, 5 mm thick, 3 cm in diameter. Consistency, spongy. Color in life and when preserved, purple. In collecting this sponge, it was necessary to detach its rather thin encrustation from the rock under water. Upon doing this, such copious quantities of deep purple coloring material were emitted that the entire tide pool, about a meter in diameter, was rendered purple. The sponge was put in a bucket of sea water to be taken to the laboratory, and this was also colored purple. The first jar of alcohol in which it was placed was colored so deeply as to become opaque, but the alcohol was changed twice, and the third filling remains uncolored, though the sponge appears as dark as ever.

Oscules, not evident as distinct from the pores (which see). Pores, skeletal, 120μ to 300μ; protoplasmic, probably up to 200μ when fully open, but closed or nearly closed in my specimen. Surface, superficially smooth, with scattered conules 1 mm high.

Ectosomal specialization, a fibrous reticulation in one plane, with meshes having openings 120μ to 300μ in diameter. The fibers are about 80μ to 180μ in diameter and are densely packed with foreign spicules; these are presumably united by spongin, but remain united during only very slight maceration, more vigorous maceration separating them easily. Endosomal structure, a minimum of protoplasm with relatively enormous quantities of foreign spicules, the

mass permeated by dendritic fibers, and all set on a tough basal plate of spongin. Ascending fibers, 80μ to 200μ in diameter, without foreign inclusions, with lamellate structure, and terminating above in the conules. (Fig. 79.)

Remarks.—Because of the enormous quantities of siliceous matter present (mostly foreign spicules) and because of the extreme opacity of the cells (they are packed with purple granules that are almost black), the difficulties in studying this sponge were excessively great. Recourse was had to hydrofluoric acid as a solvent for the siliceous matter, but the resulting material was badly shriveled and distorted, so that the method helped very little. By dint of making many sections some data can be given, however. There is a basal plate of spongin from which dendritic processes rise. These are typically about 130μ in diameter near the base, and about 0.8 to 2.7 mm high, with occasional branching but no anastomosing. The spongin is now dark, perhaps stained by coloring matter dissolved into the alcohol from the cells. Near the base these fibers are rather obviously cored with pith, but their structure is in general that of several concentrically placed cones, a hollow within the inner, smallest ones. This organization of fiber is quite typical of the genus *Aplysilla*.

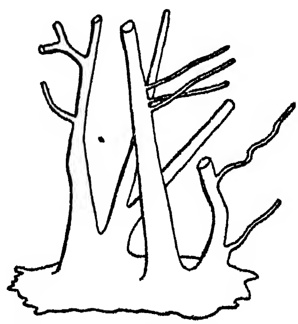

FIGURE 79.—*Aplysilla polyraphis* de Laubenfels, ×50; section of macerated skeleton; free-hand drawing

All through the flesh are enormous quantities of spicules. It would seem that every species in the vicinity was represented. There is but cramped space left for the protoplasmic structure. As the spicules are placed to avoid closing the dermal pores there is at the surface that which resembles a reticulation of foreign spicules, densely packed. From the ease with which these are macerated apart, I judge they are not held together by spongin. I find no foreign inclusions in the fibers themselves.

Very careful search was made for the flagellate chambers. I believe that in this sponge, on account of the small size of the interstices between spicules, the flagellate cells are poorly organized into chambers. I find a few that seem to be eurypyllous, about 30μ wide by 100μ long. Others in this section are round, and about 30μ in diameter. These may be cross sections of the eurypyllous ones.

On all counts, the closest species to *polyraphis* is *violacea* Lendenfeld (1883, p. 237), from Australia. It had sand grains in its basal plate of spongin, which I think is probably true of *polyraphis*. From it and all others of the genus, however, the California sponge is very widely separated by its profusion of foreign spicules.

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(SYNONYMS ARE GIVEN IN ITALICS)

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A NEWLY DISCOVERED WEST INDIAN MOLLUSK FAUNULA

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A NEWLY DISCOVERED WEST INDIAN MOLLUSK FAUNULA

By Paul Bartsch

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During the exploration of certain parts of Hispaniola during the spring of 1931, Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution, visited among other localities the island of Beata, where he and F. C. Lincoln, of the Biological Survey, obtained a quart bag full of scrapings from under the edges of stones and similar places. This material has yielded an amazing lot of new land mollusks.

Beata Island lies about 6 miles off Beata Point, the southern extremity of the island of Haiti. It is connected with that island by a submarine bank on which there are from 12 to 18 feet of water. It is about 4½ miles in length in a north and south direction, and 4 miles in width.

The United States West Indian Coast Pilot gives an elevation of 330 feet for the island, but Doctor Wetmore states that it "is low, and so far as my knowledge goes from personal observation, does not rise to the altitude given for it on current charts. Mr. Lincoln and I estimated the highest points at from 75 to 100 feet above the sea, in which regard we were joined by a resident on the island."

Doctor Wetmore also says that "the island is of characteristic limestone formation with large areas of rock bare of soil, and is much eroded. Scrub and cacti grow densely and may be penetrated only along the trails.

"The rubbish collected for shells was obtained along a space of a quarter of a mile bordering the trail going inland from the north shore. Here in places there is a shallow covering of loose soil that supports a more luxuriant tree growth than that in other sections."

The affinities of the various forms herein described are Haitian, but all are so strikingly differentiated that it is safe to believe that Beata Island has for a long time been separated from the larger island.

After the manuscript for this paper had been submitted for publication, a paper came to hand published by Dr. William J. Clench, in the Proceedings of the New England Zoological Club, which named two of the species herein described—*Chondropoma beatensis* and *Brachypodella utowanae.*

CHONDROPOMA (CHONDROPOMIUM) WETMOREI, new species

PLATE 1, FIGURES 8, 10

Shell small, elongate-conic, semitranslucent, flesh-colored, with four interrupted series of brown spots, which are arranged both in axial and spiral order. The spaces that separate these brown spots axially are about equal to the length of the spots, while the spaces that separate them spirally are more than twice the width of the spots. The early whorls are exceedingly thin, permitting the columella to be seen within. They are strongly rounded and marked by retractively slanting incremental lines only. The succeeding turns are also thin, but less so than the early whorls, and on these the incremental lines become strengthened; there are also obsolete spiral threads present, which give to the general surface a slightly malleated appearance. The suture is well constricted; the periphery of the last whorl is well rounded. The base is short and strongly rounded, narrowly umbilicated, and marked by the continuation of the axial lines which here assume almost the strength of riblets and a spiral thread marking the outer extremity of the umbilicus. Aperture oval; peristome simple and thin, not expanded.

Type.—The type, U.S.N.M. No. 403886, has 4 whorls remaining, and measures: Height, 9.7 mm; diameter, 4.3 mm.

Remarks.—The nuclear whorls were described from a young specimen having a little more than 5 whorls, of which the last shows the spotting described in the type, the preceding ones being bluish white. I have figured both specimens.

CHRONDROPOMELLA, new subgenus

Shell broadly ovate, with the postnuclear whorls inflated, well rounded, narrowly tabulated at the shoulder and marked by numerous slightly retractively slanting, closely spaced, axial riblets. The summit of the whorls is rendered feebly crenulated by the axial riblets. Periphery well rounded. Base inflated, well rounded, openly umbilicated, marked by the continuation of the axial riblets and feebly developed spiral cords between the periphery and the edge of the umbilicus. The umbilical wall is marked by stronger spiral cords. Aperture large, with a broadly expanded flaring peristome all around except at the parietal wall. The peristome not all in one

plane, but somewhat sinuous, being decidedly bent in at the umbilicus. The parietal wall appears notched on account of the absence of the expanded peristome.

Subgenotype.—*Chondropoma* (*Chondropomella*) *magnifica* (Sallé) Pfeiffer.

CHONDROPOMA (CHONDROPOMELLA) BEATENSIS Clench

PLATE 1, FIGURES 7, 9

1932. *Chondropoma* (*Chondropomium*) *beatensis*, CLENCH, Proc. New England Zool. Club, vol. 12, p. 106.
1932. *Chondropoma* (*Chondropomium*) *beatensis armouri* CLENCH, *ibid.*

Shell elongate-conic when complete, flesh-colored with interrupted spiral zones of brown. Some of these zones are fulgurated, others merely elongated dots, and still others of these dots are joined into bands, while the one below the periphery is most conspicuous and broader than the rest. The base is also marked by interrupted bands, though less conspicuously so than the spire. The inner peristome is white, while the outer is slightly rayed. Nuclear whorls 2, straw-colored, strongly rounded. Postnuclear whorls well rounded, marked by slender, slightly retractively slanting axial riblets, which are about as wide as the spaces that separate them, and which render the summit of the whorls feebly crenulated. Suture moderately constricted; periphery somewhat inflated, strongly rounded. Base narrowly umbilicated, somewhat inflated, strongly rounded, and marked by the continuation of the axial riblets. The columellar wall of the umbilicus is marked by few obsolete spiral threads near its outer margin. The last whorl is slightly solute. Aperture ovate; peristome double, the inner projecting slightly above the outer and slightly expanded; the outer broadly expanded, more so on the outer and basal lips than on the columellar border, where it is only about one-third as broad as on the rest. Operculum thin, corneous, typically chondropomoid.

Remarks.—The specimen described and figured, U.S.N.M. No. 403919, has 3.5 whorls, and measures: Height, 14 mm; diameter, 9.4 mm. Some specimens are considerably larger than this, one with 4 whorls measuring: Height, 18 mm; diameter, 11.2 mm. About 60 additional specimens, mostly dead, were obtained.

LUCIDELLA BEATENSIS, new species

PLATE 2, FIGURES 4, 5, 6

Shell minute, almost lenticular, pale straw-colored. Nuclear whorls 1.3, well rounded, smooth, excepting microscopic granules.

Postnuclear whorls 3.2, well rounded, marked by strongly retractively curved axial riblets, which grow consecutively stronger from whorl to whorl. Suture moderately well impressed. Periphery angulated. Base short, strongly rounded, with a smooth umbilical callus, which is about one-fourth the diameter of the shell. The rest of the base is marked by the continuation of the axial ribs, which become approximated and fused at the callus. Aperture slightly oblique, broadly ovate; outer lip somewhat expanded, thickened and reflected at the edge. The junction of the outer and basal lips forms a decided tooth. The columella is short and curved. The parietal wall is covered with a thin callus.

Type.—The type, U.S.N.M. No. 403920, measures: Height, 1.8 mm; greater diameter, 3.2 mm; lesser diameter, 2.9 mm.

Remarks.—U.S.N.M. No. 403889 contains 9 additional topotypes.

The present species can be distinguished at once from *Lucidella rugosa* Pfeiffer from Haiti by its much flatter shape.

EUTROCHATELLA BEATENSIS, new species

PLATE 2, FIGURES 7, 8, 9

Shell minute, broadly conic, solid, flesh-colored. Nuclear whorls 1.1, well rounded, smooth, rather elevated. Postnuclear whorls moderately rounded, separated by a low impressed suture, marked between summit and suture by faint retractively slanting incremental lines and five low, rounded spiral threads, which are almost as broad as the spaces that separate them, the one at the periphery being a little wider than the rest. Periphery angulated. Base short, well rounded, marked by seven spiral threads, which are of irregular width and spacing, and of which the three nearest the umbilical wall are the smallest. Aperture obliquely oval; outer lip expanded and reflected; inner lip reflected over the base as a conspicuous callus; parietal wall covered by a thin callus.

Type.—The type, U.S.N.M. No. 403921, has 5.5 whorls, and measures: Height, 2 mm; greater diameter, 3.3 mm; lesser diameter, 3 mm.

Remarks.—U.S.N.M. No. 403888 contains 2 additional specimens.

This species differs from *Eutrochatella eugeniana* Weinland and *E. weinlandi* Wagner in having the spiral markings less numerous and much coarser.

EUTROCHATELLA SPHAERULA, new species

PLATE 2, FIGURES 10, 11, 12

Shell rather large, globose, flesh-colored, with the early whorls tinged with pale yellow and the later with a rosy flush. The nuclear

tip consists of not quite a single turn, which is well rounded, smooth, and white. The succeeding turns are a little less strongly rounded, feebly shouldered at the summit, and marked by fine retractively slanting incremental lines and slender spiral threads. These threads are almost equal in strength and spacing. Eleven of them are present on all the whorls between the summit and suture. They increase in strength as the whorls increase in size. In addition to these raised threads, finer spiral striations are present in the interstices between them. Periphery well rounded. Base inflated, well rounded, marked by a continuation of the incremental lines and low flattened spiral threads, equaling those on the spire in width, but less elevated. Aperture semioval; outer lip slightly expanded, particularly so at the junction of the basal and outer lip and slightly reflected. Columella short, curved; inner lip reflected over the last whorl as a white callus, which extends up on the parietal wall. Operculum unknown.

Type.—The type, U.S.N.M. No. 403922, has 6.5 whorls and measures: Length, 16.2 mm; greater diameter, 16.2 mm; lesser diameter, 12.9 mm.

Remarks.—U.S.N.M. No. 403884 contains 18 additional specimens from the type locality.

This species belongs in the group of *Eutrochatella globosa* Gray and *E. opima* Shuttleworth. It differs from *E. globosa* in being much more globose, and from *E. opima* in being much larger and being even still more globose. The sculpture in the present species, moreover, is much finer in every way.

CERATODISCUS BEATENSIS, new species

PLATE 2, FIGURES 1, 2, 3

Shell very minute, discoid, pale horn-colored, upper surface of the whorls forming a concave disk. The nucleus consists of a single, rather large, smooth, well-rounded whorl, which does not project above the rest of the turns. The postnuclear whorls are marked by rather rough incremental lines, which are irregular both in size and spacing, and by slender, wavy spiral threads, of which five are apparent on the first postnuclear whorl. The last whorl is solute for about one-tenth of a turn and in cross section is broadly semioval, the columellar side being more or less straight. This whorl is also marked by coarse incremental lines and spiral threads both on the upper surface and the curved peripheral edge, and the well-rounded basal portion. The base is decidedly concave with an open funnel-shaped umbilicus. Aperture semioval; the peristome very slightly expanded and very slightly reflected at the edge.

Type.—The type, U.S.N.M. No. 403923, has 2.3 postnuclear whorls and measures: Height, 1.1 mm; greater diameter, 3.4 mm; lesser diameter, 2.6 mm.

Remarks.—U.S.N.M. No. 403897 contains six additional specimens from the type locality. This species is nearest related to *Ceratodiscus solutus* Simpson and Henderson from La Ferriere, Haiti. It differs from this in being much smaller and in having the nuclear whorls depressed in the general concave surface of the spire instead of elevated, and in having the spiral sculpture much finer.

CEPOLIS WETMOREI, new species

PLATE 3, FIGURES 4, 5, 6

Shell depressed helicoid with a pale brown band at the suture and a broader similarly colored band halfway between this and the periphery. (As all our specimens are dead, it is quite possible that in fresh material these bands will prove to be conspiciously colored.) Nuclear whorls 1.3, slightly rounded, finely granular. Postnuclear whorls 3, well rounded, a little more so near the summit than on the anterior two-thirds, which slope strongly. These whorls are marked by retractively slanting incremental lines, which are of irregular strength and spacing. Suture well impressed, the last whorl is narrow and slopes strongly toward the base. The base is broadly openly umbilicated and decidedly pinched in on the umbilical area behind the aperture to form a strong oblique tooth within. There is also a deeply impressed pit corresponding to a strong tooth on the inner lip some little distance behind the aperture. The aperture is oval and the outer lip is somewhat expanded, reflected, and thickened, the columella being very short. The outer lip is deflected downward near the aperture at the posterior angle. The parietal wall is covered by a thin callus. Within the aperture two teeth are apparent, the one extending from the columella for more than half the length of the basal lip, parallel to it a little behind its edge. The other is a very decidedly elevated, subconical structure springing from the middle of the outer lip, and extending for more than half the width of the aperture across this toward the parietal wall. This is at some distance from the outer lip.

Type.—The type, U.S.N.M. No. 403908, measures: Height, 9 mm; greater diameter, 14 mm; lesser diameter, 11.6 mm.

Remarks.—There are three additional specimens in this gathering, the largest of which has 5 whorls and measures: Height, 9.3 mm; greater diameter, 15.2 mm; lesser diameter, 12.5 mm.

CEPOLIS LINCOLNI, new species

PLATE 3, FIGURES 10, 11, 12

Shell helicoid; the early whorls pale horn-colored, the later ones flesh-colored with a broad chestnut-brown band at the summit and another one immediately above the periphery, while a third band is about as far superior to the periphery as the last mentioned is posterior to it; in other words, these two bands are separated by a light zone as wide as that separating the band at the summit from the median band. The rest of the base and the peristome are flesh-colored. Nuclear whorls 1.5, low, well rounded, marked by fine incremental lines and microscopic granulations only. Postnuclear whorls 3.5, well rounded, marked by strong retractively curved axial threads, which are rather distantly spaced, the spaces that separate them being fully four times as wide as the riblets. Behind the aperture these riblets become even stronger than on the rest of the whorls. They are also present on the base, although here they are slightly reduced. The last whorl descends considerably below the periphery at the aperture. Periphery obsoletely angulated. Base short, well rounded, and narrowly umbilicated, the umbilicus covered for three-fourths of its width by the reflected inner lip. There is a deep pit a little distance behind the aperture, slightly below the periphery, which it parallels and which corresponds to an internal fold that half closes the aperture. Another pit is hidden by the columella and this forms a basal tooth on the middle of the basal lip. The aperture is oval; the peristome is somewhat expanded, reflected, and thickened; the parietal wall is covered by a thick callus, which unites the posterior angle of the aperture with the columella; the left outline of this callus is sigmoid.

Type.—The type, U.S.N.M. No. 403909, measures: Height, 13 mm; greater diameter, 19.7 mm; lesser diameter, 16.2 mm.

Remarks.—U.S.N.M. No. 403898 contains 24 additional specimens.

This species is related to *Cepolis trizonella* Pilsbry, but differs from it as well as from *Cepolis trizonalis* Grateloup in being decidedly more conic and in having the last whorl decidedly more inflated and the sculpture stronger in every way.

CEPOLIS TRIZONALIS BEATENSIS, new subspecies

PLATE 3, FIGURES 1, 2, 3

Early whorls pale buff, the later ones flesh-colored with a zone of chestnut-brown separated from the summit by a light area equaling this band in width. A second brown band a little wider than the one near the summit encircles the turns a little anterior to the periphery, the space betweeen the two dark bands being a little wider.

Another narrow, very pale brown band is present immediately below the periphery. The rest of the base and the peristome are white. The dark bands show within the aperture. Nuclear whorls 1.3, low, well rounded, marked by incremental lines and microscopic granulations. The postnuclear whorls are slightly rounded and marked by poorly defined retractively curved axial threads. These become a little more pronounced toward the last part of the last turn. Suture moderately impressed. The last whorl descends near the aperture to considerably below the well-rounded periphery. The base is strongly, evenly rounded, marked by a feeble continuation of the axial riblets with the umbilicus completely closed. There is a strong pit immediately below the periphery and a little distance behind the aperture, which corresponds to the fold on the inside of the outer lip, which extends halfway across the aperture. The aperture is oval with the outer lip expanded, reflected, and decidedly thickened. There is a strong fold on the middle of the basal wall. The parietal wall is covered by a thick callus, which has a sigmoid outline on its left border.

Type.—The type, U.S.N.M. No. 403910, measures: Height, 13.1 mm; greater diameter, 21.4 mm; lesser diameter, 16.2 mm.

Remarks.—U.S.N.M. No. 403911 contains another bleached specimen.

This subspecies is distinguished from *Cepolis trizonalis* in being much smaller and in having the basal brown band much narrower. It is distinguished from *Cepolis trizonella* by its closed umbilicus.

PLAGIOPTYCHA (MONODONTA) BEATENSIS, new species

PLATE 3, FIGURES 7, 8, 9

Shell small, subglobose, the early whorls flesh-colored, the last three with interrupted spiral bands of brown. A continuous band of brown is present a little posterior to the periphery, which in spite of its continuity, shows circular areas, indicating spots, and between this and the summit are two zones of brown spots. There is another zone of small brown spots at the periphery and a second continuous band about as far anterior to the periphery as the other continuous band is posterior to it. The base is marked by five zones of round brown spots, which are arranged not only in spiral but in axial series. Nuclear whorls 1.2, moderately well rounded, marked by fine incremental lines and microscopic granulations. Postnuclear whorls well rounded, separated by a moderately impressed suture, marked by retractively slanting lines of growth. Periphery well rounded. Base somewhat inflated, strongly rounded, marked by the continuations of the lines of growth. The last whorl descends de-

cidedly near the aperture almost to the middle of the base. Aperture decidedly oblique, oval. Outer lip thin at the edge, scarcely expanded; the inner and basal lip are reflected over the base as a thick callus. The basal lip bears a strong denticle about one-third of the distance between the columella and the outer lip. Parietal wall is covered by a thin callus.

Type.—The type, U.S.N.M. No. 403912, measures: Height, 8.9 mm; greater diameter, 12.2 mm; lesser diameter, 10.4 mm.

Remarks.—U.S.N.M. No. 403900 contains four additional specimens.

THYSANOPHORA BEATENSIS, new species

PLATE 1, FIGURES 1, 2, 3

Shell minute, depressed helicoid, semitranslucent, pale straw-colored. Nuclear whorls 2, well rounded, polished, marked by exceedingly fine incremental lines and exceedingly fine closely approximated microscopic spiral striations only. Postnuclear whorls well rounded, showing fine lines of growth and exceedingly fine microscopic spiral striations. Suture well impressed. Periphery of the last whorl well rounded. Base well rounded, openly umbilicated, the umbilicus about one-fifth the width of the diameter of the shell. The aperture is oblique; the outer lip does not descend at its termination. Columella short and gently curved; the peristome not expanded.

Type.—U.S.N.M. No. 403917 has 4.3 whorls, and measures: Height, 2 mm; greater diameter, 3.1 mm; lesser diameter, 3 mm.

Remarks.—U.S.N.M. No. 403890 contains about 70 topotypes.

THYSANOPHORA ALTA, new species

PLATE 1, FIGURES 4, 5, 6

Shell minute, helicoid, decidedly elevated, pale straw-colored. Nuclear whorls 1.5, strongly rounded, smooth excepting fine incremental lines and microscopic granules. Postnuclear whorls 2.7, inflated, strongly rounded, separated by a low impressed suture and marked by incremental lines, the surface being rendered slightly roughened by the attachment of foreign matter. Periphery inflated, strongly rounded. Base well rounded, openly umbilicated, the umbilicus about one-sixth of the width of the diameter of the shell. Aperture oblique, and broadly oval; outer lip thin at the edge. Columella moderately long, curved. Parietal wall covered with a thin callus.

Type.—The type, U.S.N.M. No. 403918, measures: Height, 2.3 mm; diameter, 3 mm.

Remarks.—This is a member of the Boothiana group.

UROCOPTIS (AUTOCOPTIS) BEATENSIS, new species

PLATE 1, FIGURE 11, 13

Shell pupoid, the apex of the spire decollated, the upper half darker than the anterior. The whorls are slightly rounded, appressed at the summit and separated by a poorly impressed suture. The surface is almost polished, being marked by fine, retractively slanting, incremental lines and microscopic spiral striations only. The base is short, strongly rounded, with an umbilical slit, and an obsolete cord marking the line at the junction of the outer and basal lip. The umbilical area of the last whorl is marked by rather regular threadlike riblets, which are about one-half as wide as the spaces that separate them. These riblets become more closely approxi mated toward the aperture. The last whorl is solute for about one-tenth of a turn, and the aperture is broadly flaringly expanded. It is obliquely oval, with the outer edge of the peristome decidedly thickened all around. The pillar is slender, solid, and twisted and expanded into a lamella on the last half of the last turn.

Type.—The type, U.S.N.M. No. 403913, has 7.5 whorls remaining, and measures: Length, 23 mm; diameter, 9.3 mm; greatest diameter of aperture 8.1 mm; height of aperture, 7 mm.

Remarks.—Nine topotypes were obtained, the largest of which has 8 whorls remaining, and measures: Length, 24 mm; diameter, 10.2 mm; greatest diameter of aperture, 8.8 mm; height of aperture, 8 mm. The smallest has 6.5 whorls remaining, and measures: Length, 19.6 mm; diameter, 8.9 mm; height of aperture, 6.9 mm. The border of the aperture being broken prevents our giving the greatest diameter of it.

BRACHYPODELLA (LIPAROTES) UTOWANAE Clench

PLATE 1, FIGURE 14

1932. *Brachypodella utowanae* CLENCH, Proc. New England Zool. Club, vol. 12, pp. 104, 105.

Shell fusiform, flesh-colored with a brownish flush. Nuclear whorls 2, the first smooth, the second showing the beginning of the axial riblets. Postnuclear whorls increasing steadily in size from the first to the sixth whorl, after which they again decrease in width toward the base. The early postnuclear whorls are very strongly rounded, the median ones less so and the later ones very slightly so. The last one is slightly exserted at the basal carina. These whorls are marked by slender, slightly flexuose, retractively curved axial riblets, those of the early turns being almost sublamellar while those on the later whorls are more threadlike but more elevated than an ordinary thread would be. They are a little less wide than the spaces

that separate them. Suture well impressed, rendered slightly wavy by the axial riblets. The last whorl has a strong basal carina at the junction of the outer and umbilical wall, which is rendered crenulated by the axial ribs, which extend quite prominently upon the umbilical wall. The last whorl is solute for a third of a turn. Aperture almost subquadrate with the peristome expanded and reflected. The pillar is slender, solid with a median twist.

Remarks.—The specimen described and figured, U.S.N.M. No. 403914, has 10.5 whorls, and measures: Height, 7.8 mm; diameter, 2.6 mm.

U.S.N.M. No. 403885 contains three additional specimens.

MACROCERAMUS BEATENSIS, new species

PLATE 1, FIGURE 15

Shell small, elongate conic, pale brown, with darker irregular axial bands of chestnut-brown, the first two turns of the apex being pale brown, the succeeding one chestnut-brown; the aperture pale brown. Nuclear whorls 2.2, strongly rounded, smooth. Postnuclear whorls moderately well rounded, separated by a moderately impressed suture, the first three marked by rather strong, decidedly retractively curved axial riblets. After this the axial riblets become less conspicuous and more distantly spaced. The spiral sculpture consists of eight series of obsolete pits between the summit and the periphery of the last whorl. These pits appear like malleations between the obsolete riblets. The periphery is marked by an obsolete thread. The base is well rounded, marked by the continuation of the axial riblets and poorly developed spiral pittings, narrowly umbilicated. Aperture subcircular; outer lip slightly expanded and slightly reflected. Columella moderately expanded and reflected. Parietal wall covered by a thin callus.

Type.—The type, U.S.N.M. No. 403915, has 9.5 whorls, and measures: Height, 10 mm; diameter, 3.9 mm.

Remarks.—U.S.N.M. No. 403887 contains three additional specimens.

VARICELLA BEATENSIS, new species

PLATE 1, FIGURE 12

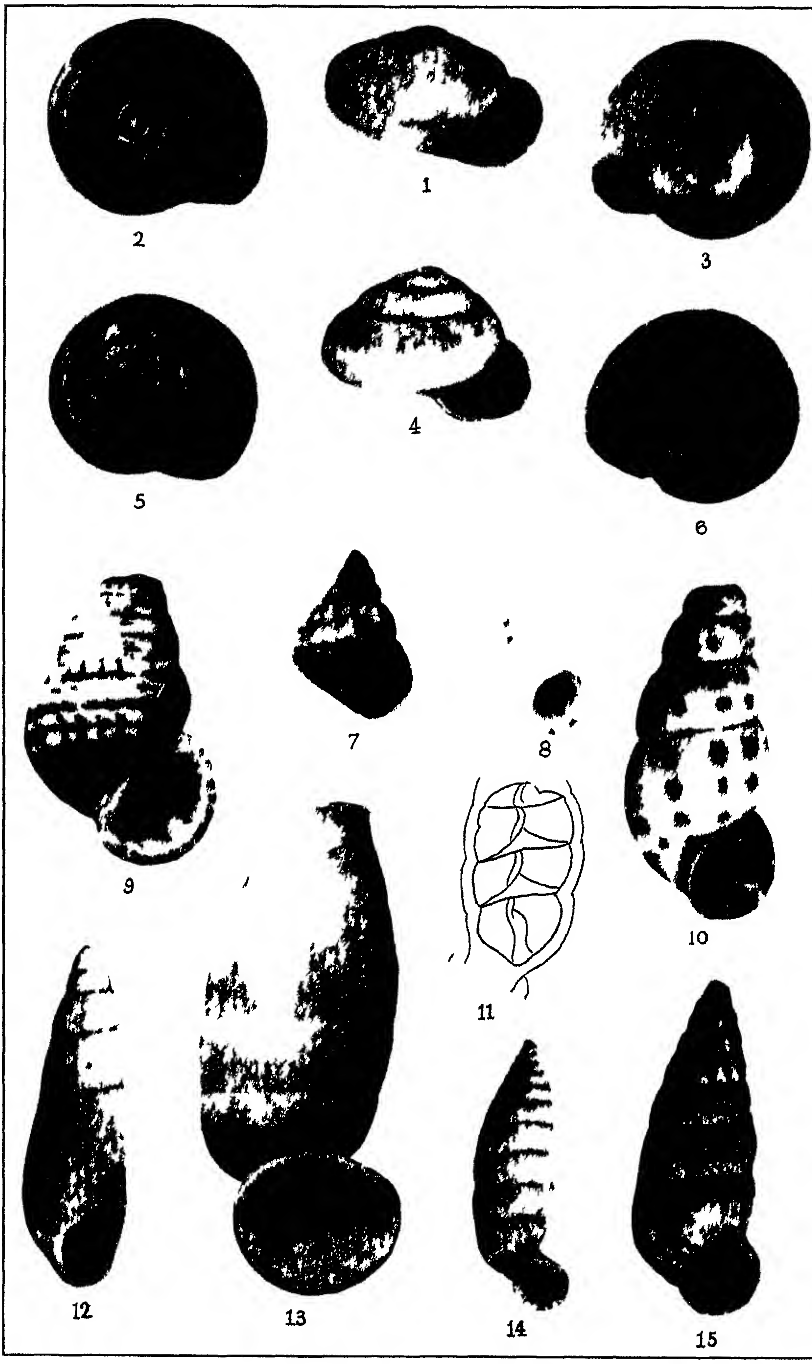
Shell elongate conic, pale horn-colored, with irregularly spaced vertical bands of pale brown, which is also the color of the tip of the columella. Nuclear whorls, 2.1, strongly rounded, smooth. Postnuclear whorls rather high between the summit and the suture, very slightly rounded, separated by the slightly impressed suture and marked by strongly impressed, almost vertical axial lines, which

separate spaces of somewhat irregular width. The summit of the whorls is not crenulated by these impressed lines. Periphery well rounded; base moderately long, well rounded, marked by the feeble continuations of the above-mentioned impressed lines. Aperture moderately long; outer lip thin; columella short, truncated anteriorly and slightly sinuous. Parietal wall covered by a thin callus.

Type.—The type, U.S.N.M. No. 403916, has 6.5 whorls, and measures: Height, 10 mm; diameter, 3 mm.

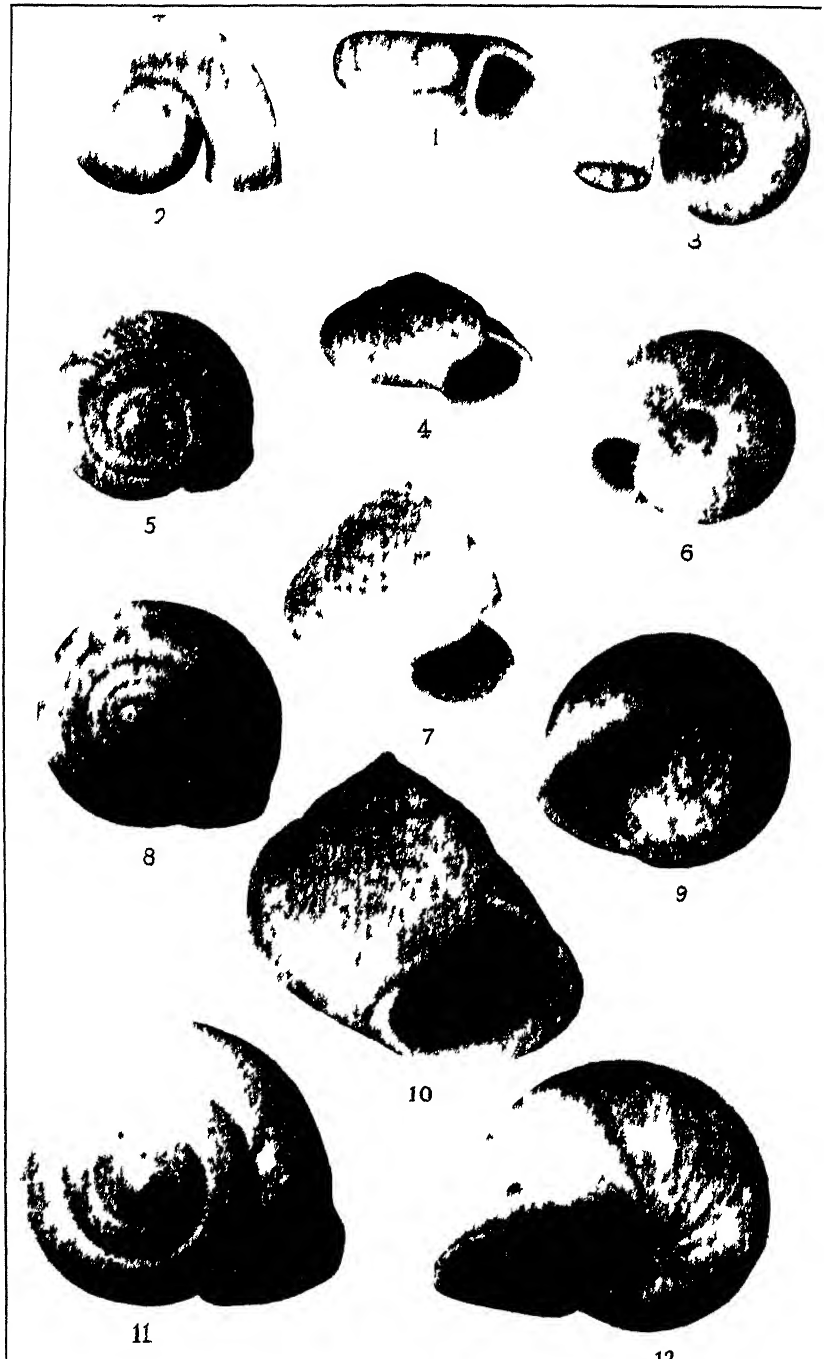
Remarks.—U.S.N.M. No. 403892 contains eight additional specimens.

U. S. GOVERNMENT PRINTING OFFICE 1932



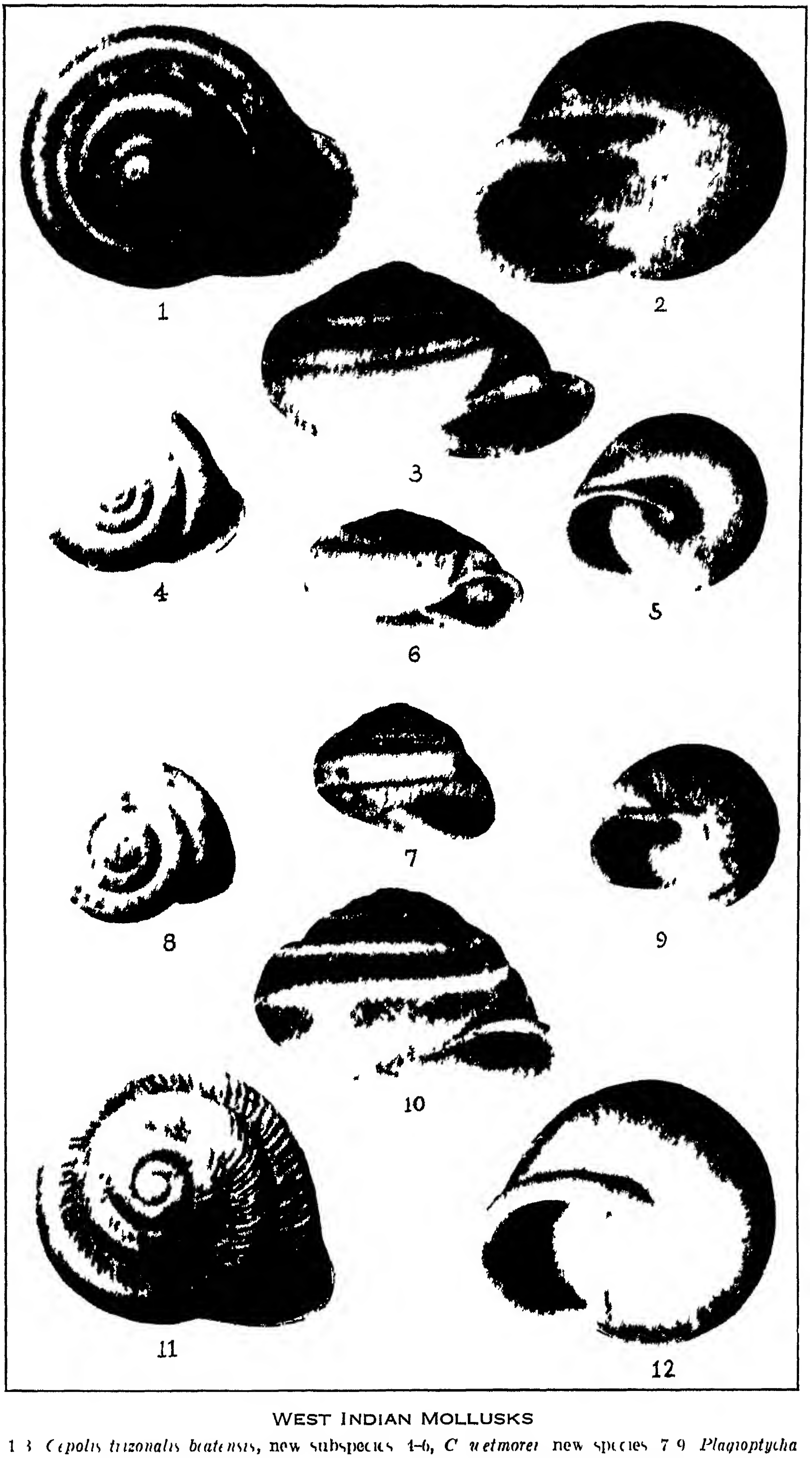
WEST INDIAN MOLLUSKS

1–3, *Thysanophora beatensis*, new species. 4–6, *T. alta*, new species. 7, 9, *Chondropoma* (*Chondropomella*) *beatensis* Clench. 8, 10, *C.* (*Chondropomium*) *wetmorei*, new species. 11, 13, *Urocoptis* (*Autocoptis*) *beatensis*, new species. 12, *Varicella beatensis*, new species. 14, *Brachypodella* (*Liparotes*) *utowanae* Clench. 15, *Macroceramus beatensis*, new species.



WEST INDIAN MOLLUSKS

1–3 *Ceratodiscus beatensis* new species 4–6 *[illegible] beatensis* new species 7–9 *[illegible]* new species 10–12 *[illegible] sphaerula* new species



WEST INDIAN MOLLUSKS

1-3 *Cepolis trizonalis beatensis*, new subspecies 4-6, *C wetmorei* new species 7-9 *Plagioptycha* (*Monodonta*) *beatensis*, new species 10-12 *Cepolis lincolni*, new species

DECORATIVE DESIGNS ON ELDEN PUEBLO POTTERY, FLAGSTAFF, ARIZ.

BY

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Head Curator, Department of Anthropology
United States National Museum

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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
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1932

DECORATIVE DESIGNS ON ELDEN PUEBLO POTTERY FLAGSTAFF, ARIZ.

By Walter Hough

Head Curator, Department of Anthropology, United States National Museum

INTRODUCTION

Elden Pueblo, located 6½ miles east of Flagstaff, Ariz., was excavated in 1926 by Dr. J. Walter Fewkes and his party for the Bureau of American Ethnology. This work, carried on with Doctor Fewkes's characteristic skill and experience, contributed much to our knowledge of the archeology of this region. Dr. H. S. Colton, of the University of Pennsylvania, who has for several years investigated and published on the ruins of this portion of Arizona, called Doctor Fewkes's attention to the Elden ruin and subsequently aided in the field work. Doctor Fewkes's report (1927) leaves little to be desired regarding all phases of the exploration. The present paper is confined to a study of the decoration of the Elden Pueblo ceramics collected by Doctor Fewkes.

Intercourse by Indian groups scattered over a very wide region in northeastern Arizona was promoted by the prominence of San Francisco Mountain in Pueblo cult. In Pueblo mountain worship the peaks were regarded as shrines, and tribes came from great distances to them for worship. Cloud, rain, and water cults were ordered in response to the meteorological energy of the high peaks, which affected the weather over thousands of square miles. The Pueblo Indians had probably observed the relation of the mountains to weather phenomena centuries ago.

San Francisco peaks as a cult focus would thus be responsible for any introductions of foreign elements in the materials from ancient pueblos. This is merely suggested as one of the ways that intrusive specimens arise, especially from regions widely separated.

POTTERY

General remarks.—Elden Pueblo is classed as a gray-ware site, one of the many northern type settlements penetrating the Little Colorado region and situated south of the great escarpment called the "rim." It is evident that this ruin dates from the Great Period of Kidder and that it was established a very long time before the

intrusion of a development of the varied polychrome ceramic art of this region.

There is no longer question that the focus of the gray-ware art was in the San Juan drainage, since Dr. F. H. H. Roberts's explorations in Pueblo I ruins in the Piedra district show not only the beginning of Pueblo Indian pottery, but also that the first ware was of the gray type. (Roberts, 1930.) This is a clear case of the influence of environmental clays on the formation of a ceramic type. With this fact in view, the polychrome, orange, yellow, and brown classes are seen to depend on the original sedimentary clays of the Jurassic and Cretaceous and resedimented clays from older and later periods spread out on the eroded strata.

Over a very large area north of the Little Colorado, archeologists have noted in small house sites shards of gray ware on which the decoration appears faded. These sites, which were much weather-worn and gave an impression of antiquity, were for a long time an enigma. More intensive work in the Pueblo region has revealed that this ware seems to have been dispersed from the Kayenta focus during Pueblo III period. It may be surmised that the distribution of gray ware of the class mentioned was toward the south and west from the Kayenta focus. This is borne out by the character of the decoration (see pl. 1 and pl. 3, fig. 3), which may be called diffuse, while from the other major focus in the San Juan appears to emerge the sharp-cut designs in dark pigment not covering the whole surface of vessels. The priority seems to be with the San Juan, but the greatest development in an art sense occurs to the westward, and its distribution is southward in Arizona. Placed on Doctor Kidder's base map graphically, the gray-ware centers are shown in Figure 1. The dimness or clearness of the decoration is probably due to the medium used, possibly water in the case of the faded designs and seed oil in the clear ones. With the iron pigments, water would give a thin paint and oil more of a mass of color. (Hawley, 1929.)

Evidently the gray ware continued over so long a period and became fixed to such an extent that when a group of Pueblo Indians moved into a locality where it was not possible to obtain the clay to produce the ware, they practiced slipping with white clay over a local body, the kaolin evidently being brought in small quantities from a long distance or obtained from detritus from old formations.[1] There is evidence that halloysite, a white claylike mineral near to kaolin, was gotten from the ancient gravels along the Little Colorado. Halloysite shrinks considerably and tends to warp in firing, a feature noticed frequently in southern gray ware.

[1] Kaolin for ceremonial purposes is brought by the Hopi Indians from a butte southwest of Walpi, where novices are taken for their initiation into the fraternities.

It is necessary, of course, to treat each site or contiguous groups of sites as a unit, and to study the developments of the potter's art locally. Later it may be possible on the completion of such studies to bring to bear correlations covering larger areas. By this means we may trace the spread of types of ceramic art from an original focus and allow for expedited or retarded developments in the unit sites, and also estimate the dates of pronounced styles of decoration. The study of the Elden ceramics is made on this basis. Gray ware in pueblos that represent the consolidations and siftings of tribal decay and movements reflects in its heterogeneity these movements. A typical case is the confusion of forms and designs in Kidder's adobe pueblo near the Pecos ruin.

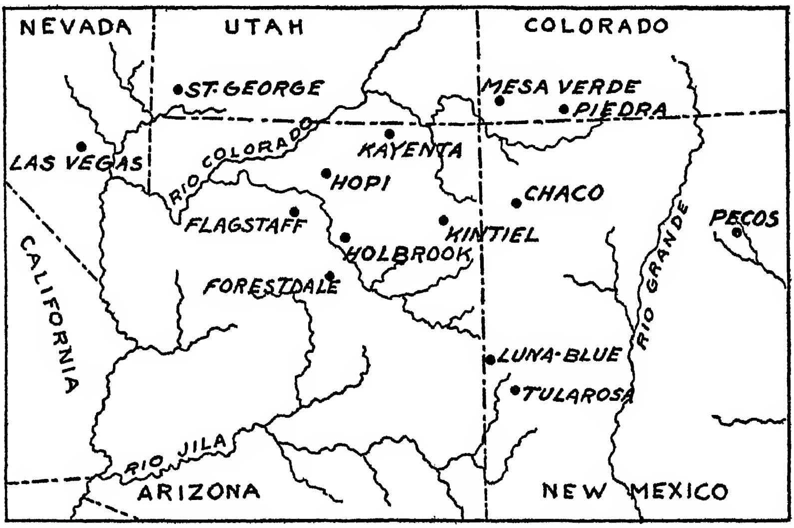

FIGURE 1.—Map showing gray-ware centers, Rio Colorado and Rio Grande regions

Description of the designs.—Elden gray ware divides itself rather sharply into two classes of decoration, one in bands and the other in quadrants.

In bowls the band decoration leaves a circular area in the bottom and the 4-part design a square area. (Pls. 1, 5.) The bands enforce the seriation of the design elements in repetitions, and do not allow the exercise of the ingenuity that is possible with the quadrants.

Band decorations are very old in the pueblo region. They may be said to originate in the partial decoration of the earliest pottery, the lip borders and shoulders of the ware being ornamented with clipped designs framed in a restricted space. The character of these designs leads one to believe that the disintegration of symbolic motives into patterns may be earlier than has been thought. The

Elden band designs considered in connection with the character of the forms and other criteria of the pottery so decorated indicate that this ware is the oldest found in the pueblo.

The simplicity also of the band designs gives the ware the aspect of maturity, and there is a fixity of the decorative art of the potters not observed in other gray ceramics thought to be of a later period. It is possible that an examination of the stratigraphy at Elden Pueblo may corroborate this assertion.

Band designs are accompanied by parallel stripings; the lines are continuous around the concavity of a bowl or the swell of a vase, their purpose being to border or to space the bands. (Pl. 1.) Rarely short, unmodified lines were used in the decoration of the banded ware, and these outline the central symbol of the repeat. The horizontal lines number from one to five between the bands.

Both bands and lines are applied in agreement with the structure of the ware, that is, on the coiling junctions, which are always horizontal. The lines probably do not originate in the desire to simulate coils showing on the surface, as in the familiar corrugated ware. In the early period corrugated pottery was made very sparingly and appeared on the necks of vessels as flat strips rather than as rounded relief coils. It is interesting to observe, however, that the band effect is frequently noted on the finer coiled ware of a later period, when coiling reached the plane of art. This is accomplished by the modification of a series of coils at intervals. (Hough, 1903, pl. 80.)

Bands did not disappear at Elden Pueblo with the coming of quadrant art, which is also old and was introduced from the north here. They are evident in the short sections of bands worked into the quadrant figures. Occasionally in the Little Colorado polychrome ceramics short diagonal sections of bands appear in bowls. A discovery of this sort from the Petrified Forest shows a departure from the customary structural type and seems to be purely decorative. (Hough, 1903, pl. 15.) The canteen (pl. 5, fig. 2) shows that at an early period sections of bands were used in decoration.

The fine specimen shown in Plate 2, Figure 1, is the most archaic in feeling of the vessels decorated in band patterns. The decoration is suggestive of the coiling lines discussed above. Interposition of parallel line bands with diversified bands is seen on the large bowl shown in Plate 2, Figure 2.

Allied to the band series are all-over designs made up of a network of interlocking diagonal strips applied to the interior of bowls. (Pl. 6, figs. 2, 3.) Doctor Fewkes was especially interested in these unique designs and figured them in his report (1927).

The designs in quarters, or quadrant designs, which are frequent in Elden gray ware, seem to mark a profound change in Pueblo

ideas of cosmogeny. The change seems to have been based on the axial or square cross developing from the use of sunrise and sunset as datum points for the regulation of ceremonial periods. The arms toward sunrise and sunset from the position of the observer would, it is conceived, insensibly require balancing by other arms extending north and south, thus dividing the earth into the quadrants of Pueblo mythology.

When this change took place is not determined, but it appears likely that it began at Elden in Pueblo III following a considerable development in pottery decoration through the preceding periods, fostered by a similar evolution of ceremonial practices and beliefs.

The adoption of the 4-part design relieved Pueblo ceramic art from pettiness and laid the foundation for the majestic decorations of the Great Period. Not only were boldness and variety introduced, but the idea of motion or rotation appeared with the world region cross, noting an advance in cosmogenic conceptions. Few designs of this character lack the element of motion.

Designs in other numbers are in the Elden collection, but these are either merely repeats or fives, apparently based on optional spacing of the area to be decorated. The so-called triskelon, three divisions, rather frequent in the Mesa Verde region, is not found at Elden Pueblo. One inexpertly decorated bowl of the lined background class, to be mentioned later, shows a decoration in three parts. (Pl. 7, fig. 6.) One curious specimen is a vase decorated with five bird conventions in geometrical figures, a hooked design outlined in black set on a lined background. Generally this design is interlocked with an opposite crooked design, producing a flowing pattern. In this case the figure is wrenched from its context.

Of decorations put on to cover pleasingly the whole surface of a vessel there are a number in the Elden collection. The design is a repetition of a simple motive, as a terraced figure connected and running diagonally, generally on vases. Sometimes broad bands in bowls are of this character. The age of this style in decorative art is incontestable; also it does not come down to modern Pueblo art. In this respect the ancients were more advanced than the modern pottery decorators. It appears to originate in the border ornaments of ancient pottery mentioned on page 3. In this style there is no number order recognizable, but there is skill displayed in spacing so that the design will connect evenly. The bold and smooth march of the decoration would seem to indicate a use of metrics, so great is the difficulty of spreading equally the design diagonally over curved surfaces with no guide of stitches, as in weaving and basketry. It is not possible, however, to assert that anything but free hand was employed by the potter.

A specimen of globular vase with the handle decorated in small squares and oblong narrow strips of black and white was found at Elden Pueblo. (Pl. 4, fig. 2.) This sliced design is curious and appears to relate to the ruled squares or mosaic pattern. The design is something like the Kayenta examples figured by Kidder (1924, pl. 31, fig. b). Another vase has the white background divided into squares. (Pl. 4, fig. 3.)

A residue of pottery that must be placed in the class of individual or extemporaneous designs is interesting as showing the mutations of art arising in an enclave where traditional forms rule. Generally such designs show a softening of the authority of traditional concepts and usher in the proliferation of designs so marked in the Little Colorado area. The extent of this change is especially appreciated when there appear new designs not derived from the ancient formula.

This class may be termed "lined-background gray ware." (Pl. 7, figs. 5, 6.) Its distribution has not been worked out. A specimen from Mesa Verde is figured by Kidder (1924, pl. 25, fig. left 3), and one from Blue by Hough (1914, p. 48), so that its range is wide, and this type may prove valuable in distribution study.

Not only are the designs notably different, but their connection with an intentional background renders this ware unique. Except as noted, the use of a painted background is not found in Pueblo ceramic decoration.

The decoration used universally by the Pueblo potters produces an interplay of decorated and undecorated areas characteristic of good design, but in many cases the observer is left in doubt as to whether the painted or the clear spaces form the pattern. In the development of the decoration to the high point to which the Pueblos carried it both ideas may be true. Originally, however, the painted figures were to be read as the meaning of the design.

The backgrounds of the class of ware mentioned are gradined with close parallel lines not systematically inclined over the whole area, showing lack of skill. The obvious intention is to set out the design in white, a departure from the general intent of the painted design.

Lining or hachuring of opposite elements of Pueblo designs is uncommon in the Elden ware and appears to belong to a later period than the banded and quadrant-decorated specimens. The intention of hachured designs is obscure. It can be for variety or may have a symbolic meaning of duality. (Hough, 1914, p. 50.) This treatment almost completely passed out of use at the close of the Great Period and the time of the discontinuance of gray ware, about 1250 A. D., as derived from dates furnished by Dr. A. E. Douglass from Pueblo Bonito beam chronology.

Red ware at Elden Pueblo in recovered specimens is scanty. The per cent of red fragments in the débris is not indicated, but it seems probable that the proportion of red ware to the gray is in line with its occurrence in typical gray-ware sites.

Red ware is primarily a gray-ware body washed with ocher and represents the first application of surface color in the Pueblo region. An inferior paste was used, producing fragile vessels usually faring badly in burial offerings or in chance occurrences in débris. The true proportion of red to other wares, therefore, is not found in the recovered ceramics. A rough estimate of the proportion may be arrived at by making a percentage count of shards in the débris, and it is recommended that this method be followed.

Of the few pieces of red ware from the Elden Pueblo collection, there is selected for description a bowl of Proto-Kayenta type decorated in red stripes outlined in black on a buff base, the designs simple and conforming to the quadrant arrangement. (Pl. 9, fig. 2.) As only a few examples were found, and as there was an absence of similar shards in the village débris, it appears likely that this pottery came directly from the Kayenta art focus. Another well-preserved bowl of rather thick ware was probably of ceremonial importance. The interior is decorated in black with a band of terraced figures arranged between series of five parallel lines as in the band class. On the exterior are white horizontal lines, and eight representations of human hands in white between two ribbons of white. On the bottom ring of the bowl is a circle of miniature hands, bird tracks, and other figures now obscured by rubbing. (Pl. 9, fig. 3.) Since occasionally specimens of this description are found in the Little Colorado area, they appear to show southern influence on the San Juan red ware.

Another variety of red ware has a deep-red interior decorated with black outlined with white. The exterior is dark-yellow ocher with a band of red washed on roughly. The paste is homogeneous and granulated with small quartz pebbles. This class of red ware is widely distributed, occurring in quantity in the Little Colorado region and south of the escarpment on the streams of the Gila-Salt drainage.

A small, thin wall bowl of dark-red ware with design in narrow lines may be regarded as another variety closer to the southern than to the northern type. The paste of this and of specimens from the Little Colorado Valley, found usually in small house sites, is so perishable that the damp vessels can rarely be removed entire from the ground.

A second bowl of this character has a gradined background outlying a swastika figure built on the prolonged sides of a square.

The arms are terraced, as in the normal cloud design, but each has two conventional eyes, suggesting that the stepped figure is intended to represent an animal, probably a bird. This is a startling design. (Pl. 9, fig. 1.)

It is seen that Elden red ware takes on the variety of paste and design of the polychrome area characterizing the valley of the Little Colorado. The presence, however, of Proto-Kayenta polychrome in the finds at Elden Pueblo is in keeping with the large proportion of quadrant clear black decorated gray pottery recovered from this site by Doctor Fewkes. The other reds are as stated, southern and seemingly later than the Proto-Kayenta ware—as is the gradined background type with aberrant designs.

Elden coil ware bowls all have polished black interiors. The coil treatment is parallel or diagonal. (Pl. 10, figs. 1–5.) Some specimens are deeply furrowed and others slightly smoothed down, as in southern coil. One bowl has a handle. The colors are gray, red, and deep brown. So far as the artistic treatment of coiling is concerned, the Elden potters were resourceful. One red bowl has a coiled exterior, a feature very rarely seen in specimens of gray ware. One globular vase is surfaced with fine parallel coil, and a good effect was produced by small wedge-shaped indentation on the coil. (Pl. 10, fig. 3.)

As usual, two forms are found at Elden: Bowls, sometimes deep, and vases. The bowls have an everted rim and in some case a smooth band under the rim. They vary considerably in small details of form. (Pl. 10, figs. 6–9.)

The preponderant pottery at Elden is a thin, red-brown ware used for domestic purposes. In most cases it is carefully finished, but no decoration is ever applied to it. The surface is generally of varying shades of color due to open-kiln firing. In bowls of various forms the interior is smoke blackened, giving a lustrous surface. The everted rims of globular vessels appear to be painted with the black pigment used in the decoration of the gray and red ware. Obtaining a smoke-blackened interior and at the same time an unsullied exterior is to be regarded as a triumph of the potter's skill. (Pl. 10, figs. 6–9.)

Brown ware rarely occurs in northern gray-ware sites, but it has an extended distribution in the Little Colorado Valley, over the rim into the Gila drainage, on the Lower Colorado, the desert country along the southern boundary and into Mexico, and in the Shoshonean area of southern California. It appears to be a product of local volcanic clays. In parts of this region brown ware is the sole ceramic product; in others it accompanies the polychrome or other local decorated pottery.

The forms of brown ware are ordinary bowls, deep globular bowls, globular vessels with rim, cups, dippers, miniature vessels, and quasi-archaic figurines of animals (see pl. 10), showing that its use is far more comprehensive than the gray ware. It is noted that the plain brown ware exhibits no handles. There is much ground for the belief that the brown ware is the basic type of the majority of the Pueblo ruins in the southern areas, and we frequently observe that gray ware has been superimposed upon it, as at the Elden site. The unctuous volcanic clays no doubt played an important part in this matter.

The finds at Elden Pueblo contain but two specimens of modeling exclusive of the rude brown figurines mentioned. One is a bird-form vessel (pl. 8, fig. 1) in red-brown ware, a type occurring widely in the Pueblo region in sites of every class of ware, the best specimen being the gray example from the Tularosa in the United States National Museum. The other is an outstanding gray-ware quadruped-animal-form vessel related to examples found in southern gray-ware sites, such as the Tularosa pueblos. The figurine appears grotesque, but it is probably intended to represent a deer in the act of "belling." (Pl. 8, fig. 2.) The painting is pale, as if faded, giving the specimen the appearance of antiquity as observed in the band decorated ware. It may be assumed that this specimen was brought to Elden Pueblo from some other locality, perhaps Kayenta, where like specimens have been found.

Motives.—It is apparent that the whole decorative field of the Elden pottery is elaborated from the bird motive. The bird symbol, which comes under the definition of a symbol because it is a figure expressing a complete idea, is in its early form not realistic, but the two engaged spirals or geometric plans generally arising each from a triangular or wedge-shaped base are taken to be the body of the bird. This symbol is seen in the banded specimen (pl. 2, fig. 2) believed to be the simplest form, and as such occurs on the earliest pottery.

Its origin is evidently not with the earliest pottery discovered by Dr. F. H. H. Roberts (1930) in the Piedra, where it occurs as a complete symbol, but probably was anteriorly developed as a religious symbol and used, as it was in Hopi fraternities, on perishable cult paraphernalia. No other symbol is so spread in space and time as that derived from the bird, and it may be asserted that it is characteristic of ancient Pueblo ceramic decoration.

The bird symbols occur in various stages of convention on the Elden pottery, but, as stated, they are always conventionalized. Also, the figures are as a rule represented as two birds in apposition. The simplest and probably the most ancient form seems to be

curvilinear, as expressing motion, which may be units or joined in a scroll; the bird's body is shown, either in the curvilinear or geometric method, as a triangle , or the clipped decoration may be a simple triangle sometimes supplied with head and tail (Hough, 1914, p. 48, fig. 85), and this seems to occur much later than the period of the Elden ware and at a time when a 4-bird convention became prevalent in Pueblo art. The 2-bird symbol is the rule in Elden Pueblo pottery, only one bowl, unmistakably of the latest period of Elden art, having the 4-bird symbol. This bowl (pl. 7, fig. 3) is the only specimen having a design in the plain circular area of the bottom.

The list of small units of design in the Elden pottery is not long. Those that are not clipped symbols, as the bird symbol simplified in various degrees, are the toothed line , occurring here in a very few instances; the serrated line , in which the triangular serration points are slanted diagonally and when drawn in apposition inclose a zigzag in white; very rarely a line crossed diagonally with short lines, ; a terraced figure , sometimes representing a bird's head having offsets or terrace designs in apposition, producing a stepped white line; terrace figures built up of blocks used in all-over decoration; oppositely placed bird convention ruled into blocks like mosaic ; areas of small blocks with dots in the center, called plumage design ; the same stopped out with black, leaving a white circle with dot in a black area, a customary method of producing an eye; designs in small white squares in a black field; series of diagonal parallel lines used to separate figures /////, or bands and hachuring; short lines connecting or completing figures in composition; wide black stripes outlining figures in apposition with similar figures hachured.

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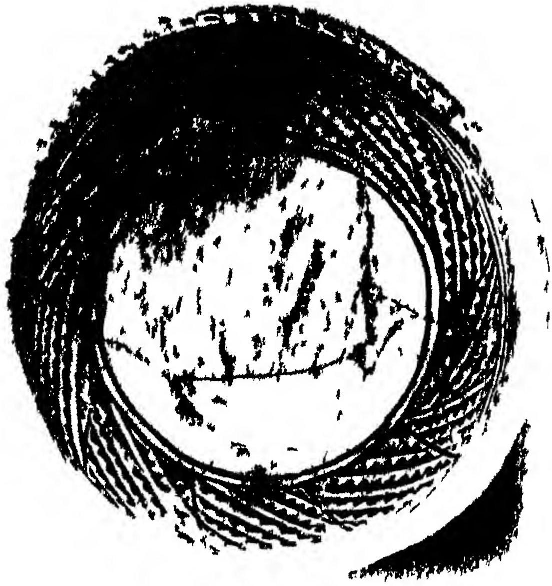


1

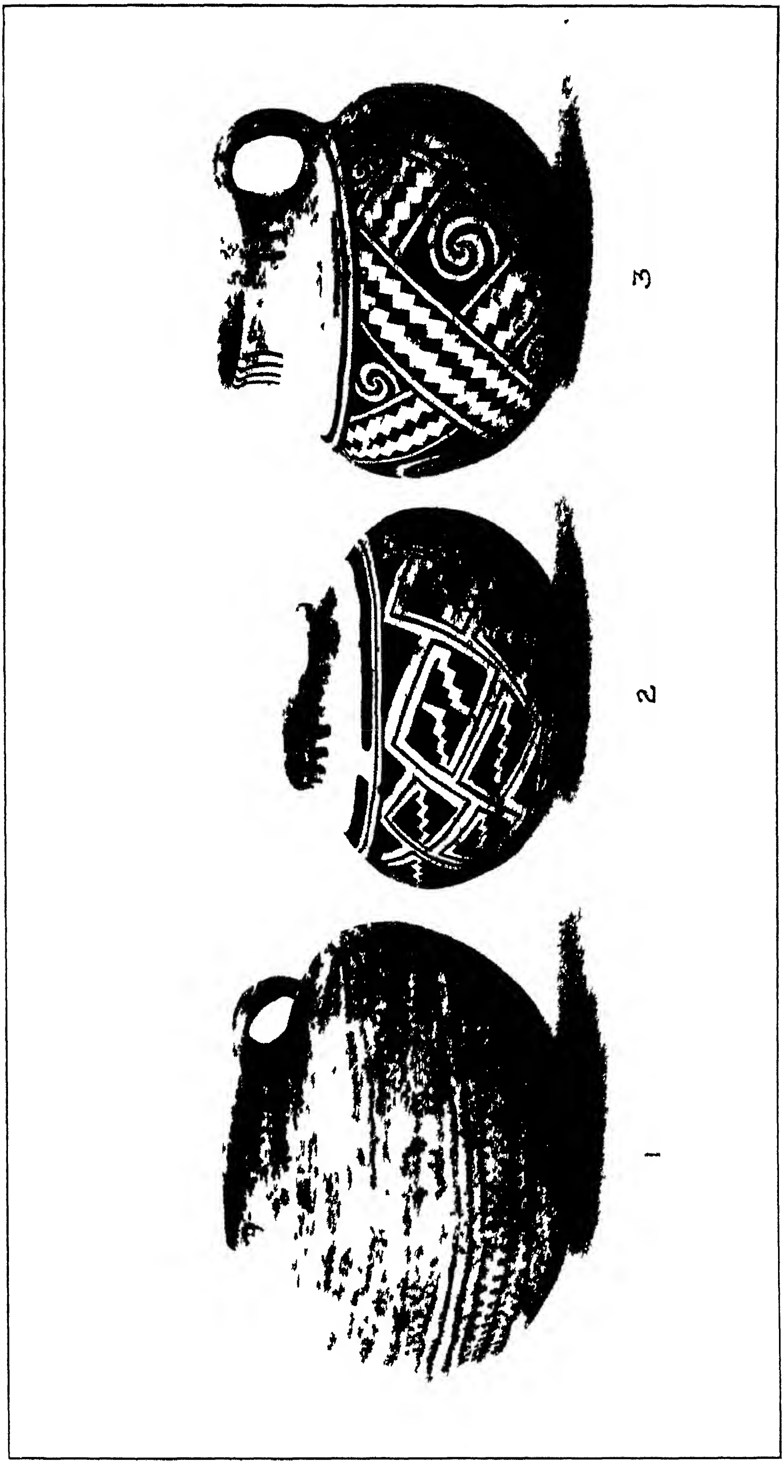
2

BOWLS WITH BAND DESIGNS

1 U S N M No 337288 2 U S N M No 33728

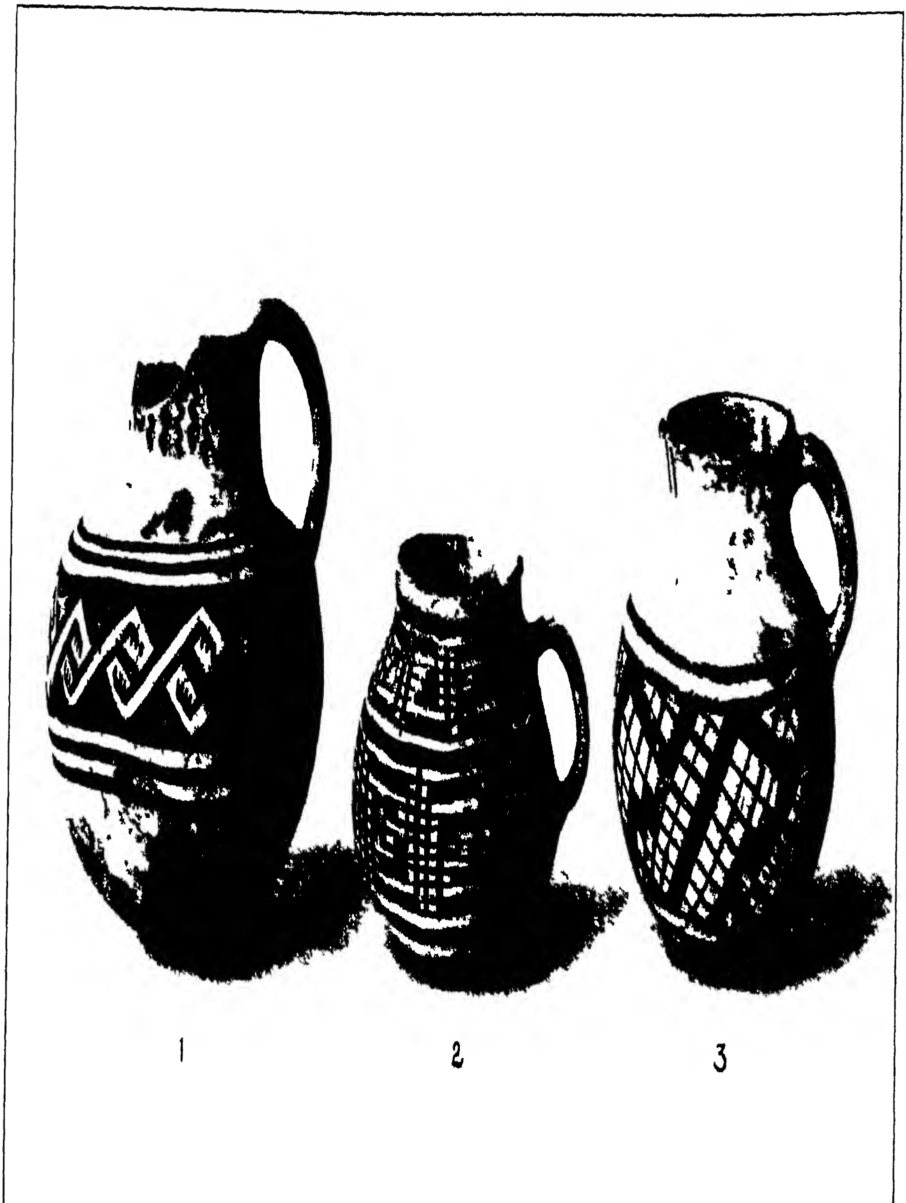
BOWLS WITH BANDS OF LINES ZIGZAGS AND SPIRALS

1 Incised bowl (U S N M No 337240) 2 large bowl (U S N M No 3372[illegible]2)



HANDLED VASES

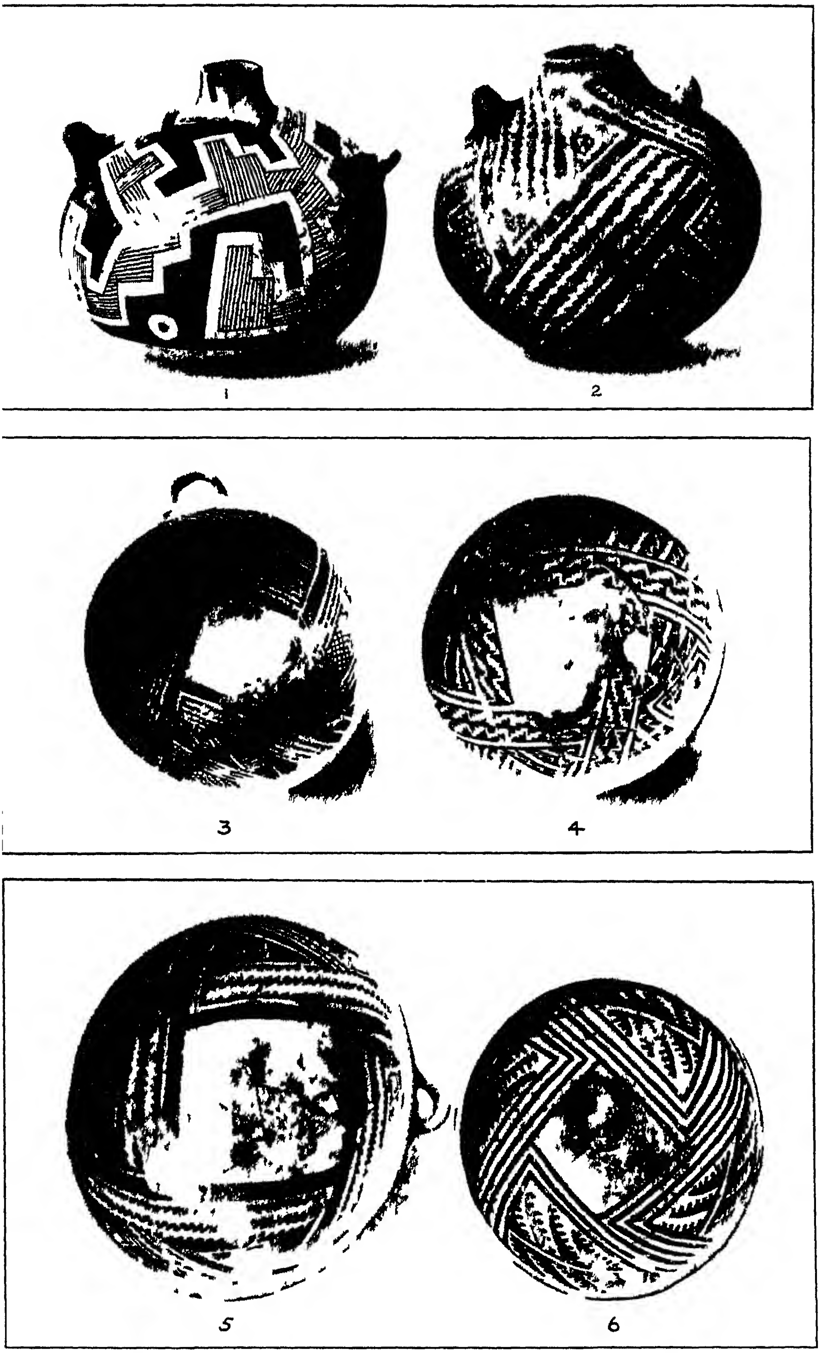
1, Band design (U S N M No 337243), 2, single band of closed fret design (U S N M No 337253), 3, broken band design (U S N M No 337237)



1 2 3

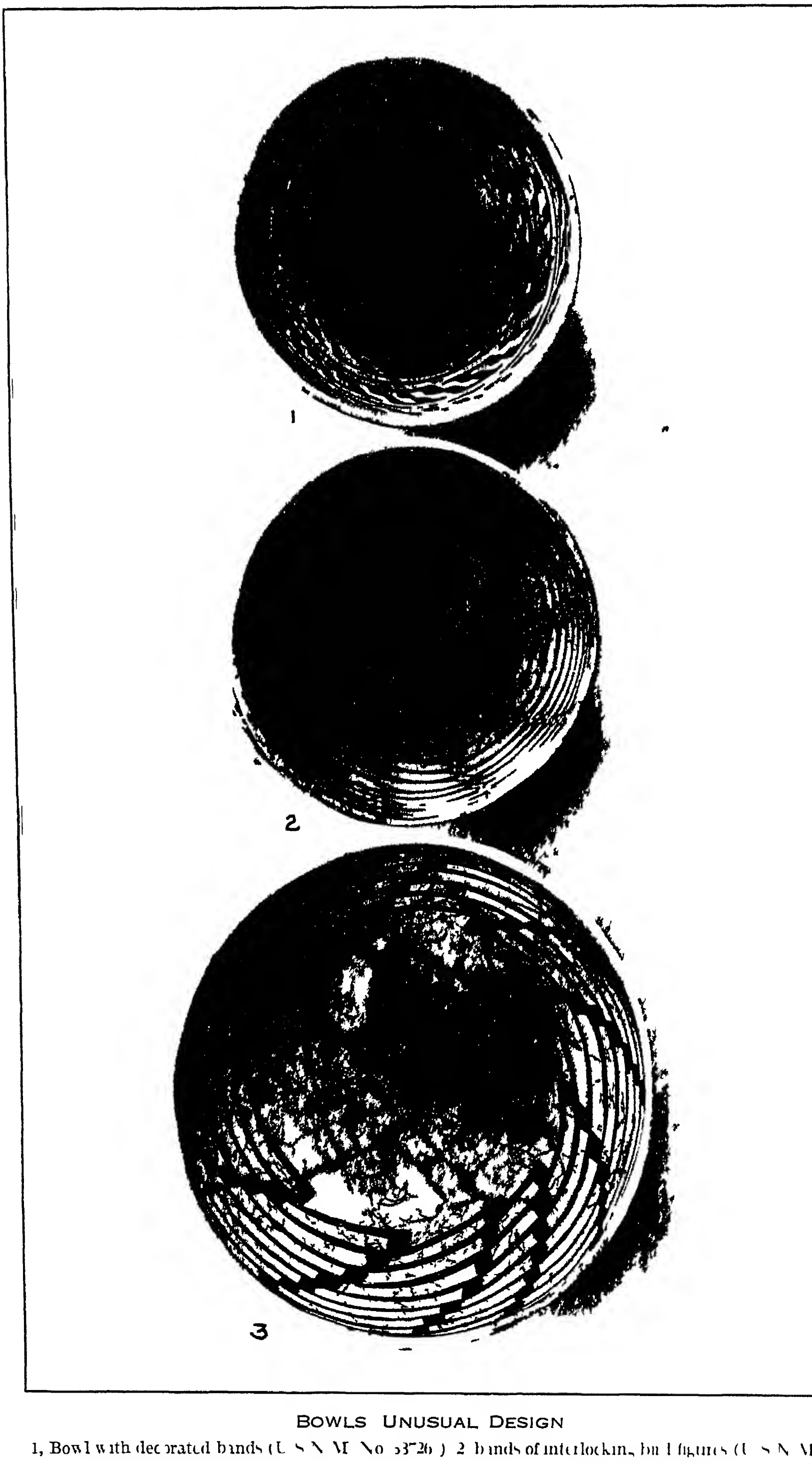
HANDLED VASES

1 Band with apposed feet (U. S. N. M. No. 337239) 2 short line mosaic design (U. S. N. M. No. 337236) 3 mosaic designs in squares (U. S. N. M. No. 337232



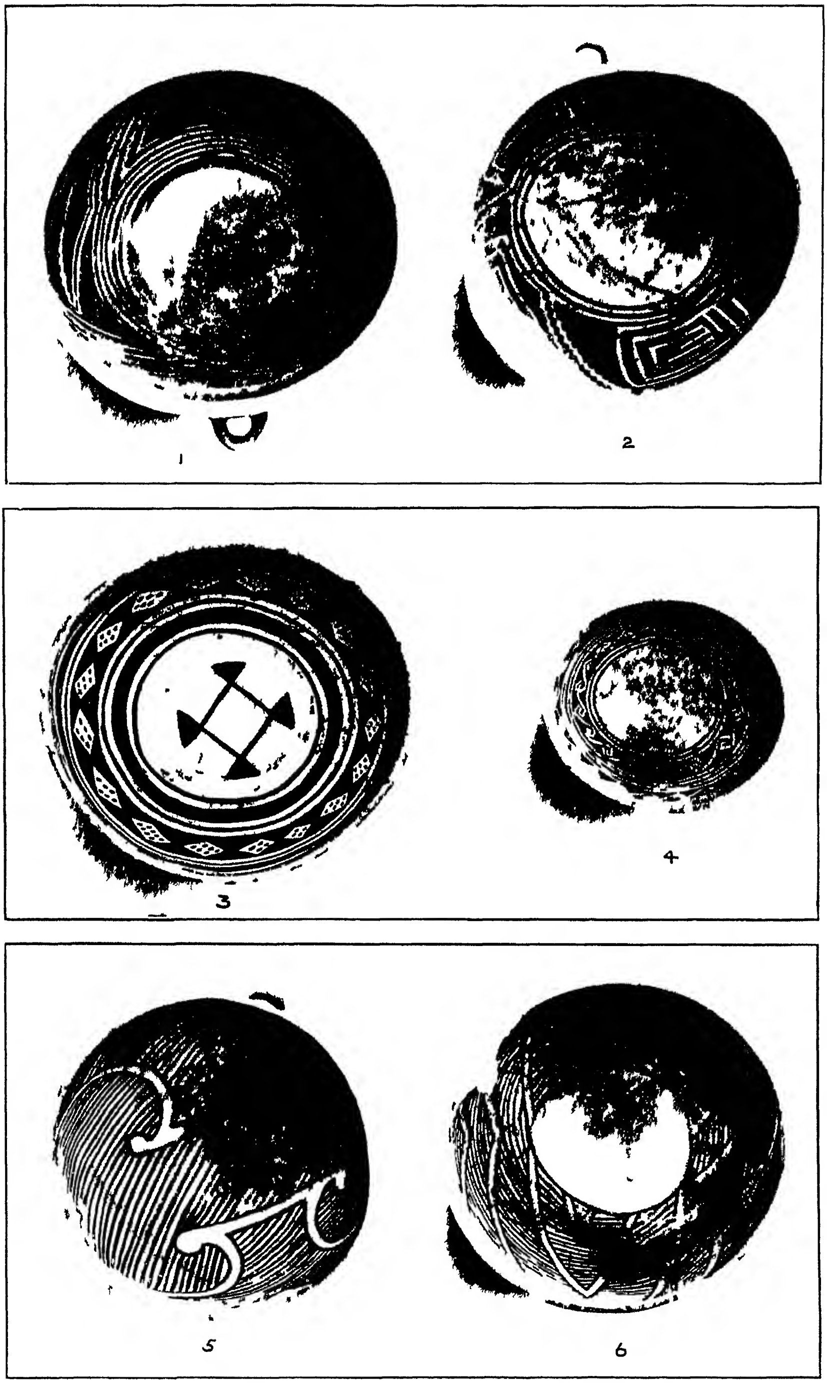
CANTEENS AND BOWLS

1, Frets in hachure and black and white (U. S. N. M. No. 337247). 2, diagonal band sections (U. S. N. M. No. 337248). 3, quadrant design (U. S. N. M. No. 337273). 4, bands arranged in quadrants (U. S. N. M. No. 337287). 5, modified band design (U. S. N. M. No. 337292). 6, greatly modified band design (U. S. N. M. No. 337282).



BOWLS UNUSUAL DESIGN

1, Bowl with decorated bands (U. S. N. M. No. 33726) 2, bands of interlocking bird figures (U. S. N. M. No. 337279) 3, squares and lines forming diagonal terraces (U. S. N. M. No. 337263)



BOWLS, GRAY WARE, BLACK DECORATION

1, Linear decoration (U. S. N. M. No. 337278). 2, lines and fretted decoration (U. S. N. M. No. 337284). 3, bowl, advanced design (U. S. N. M. No. 3372[illegible]8). 4, band design, cross in field (U. S. N. M. No. 3372[illegible]). 5, unusual design, gray-lined background (U. S. N. M. No. 3372[illegible]8). 6, gray-lined background (U. S. N. M. No. 3372[illegible]).

2

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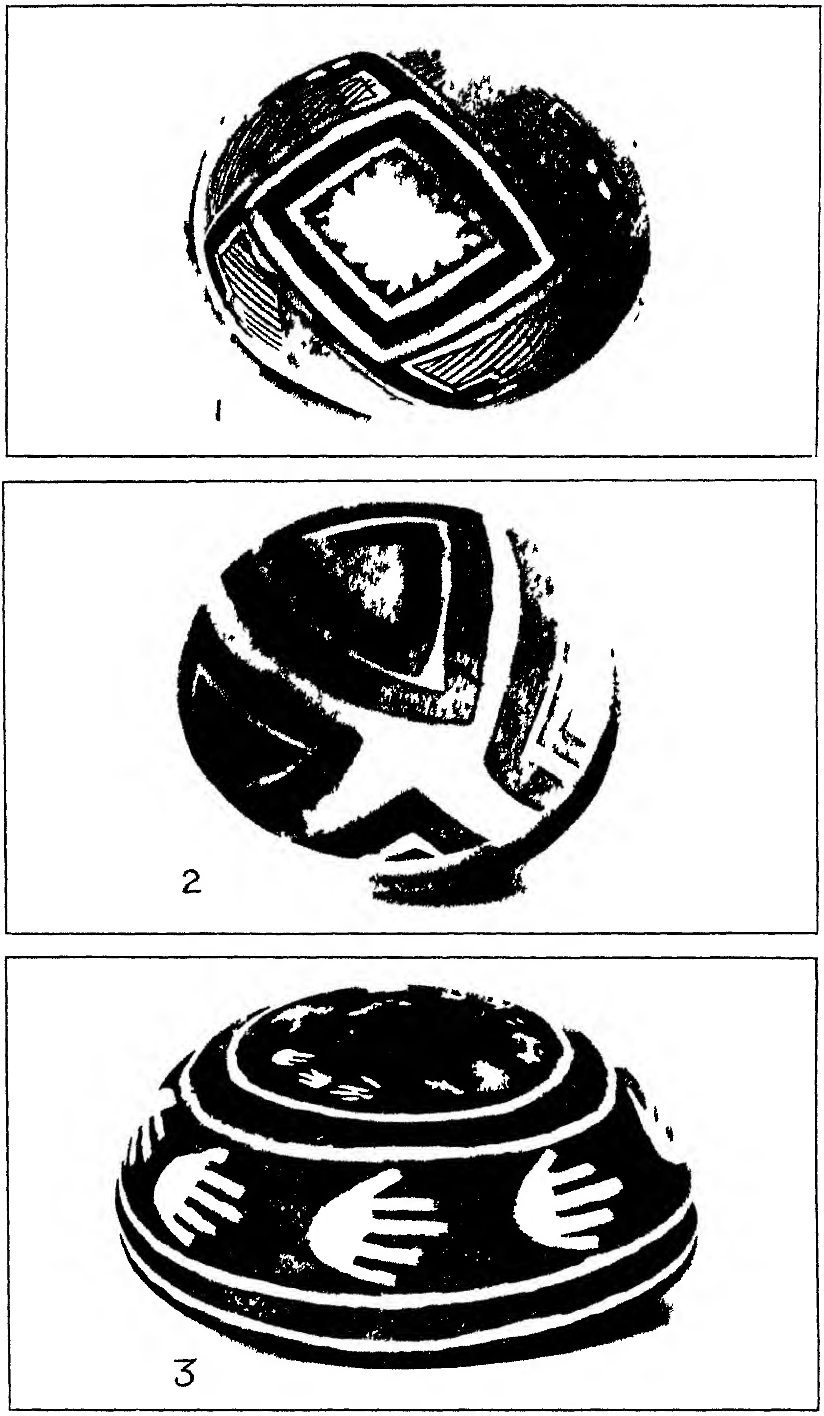
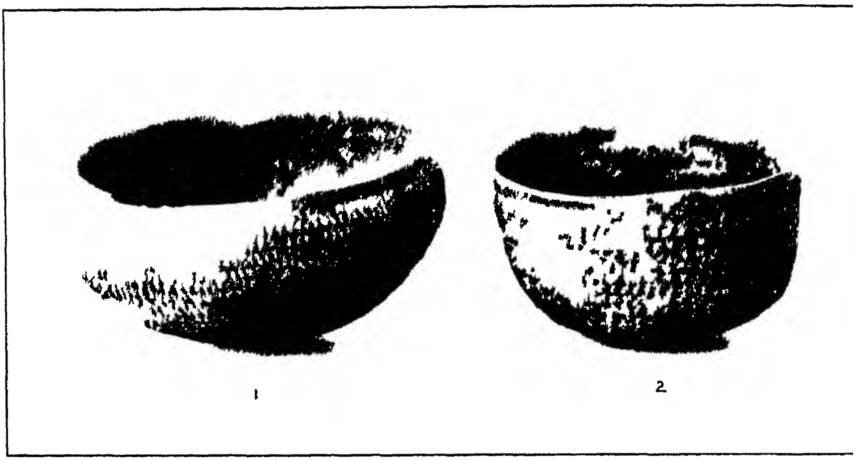
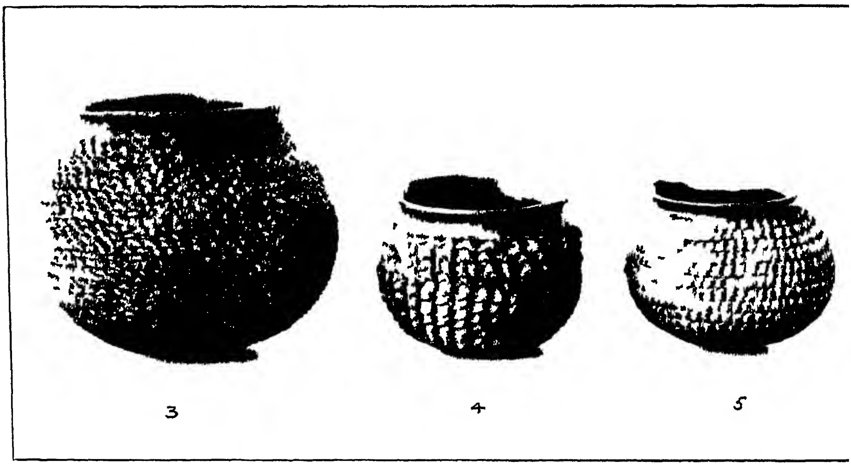
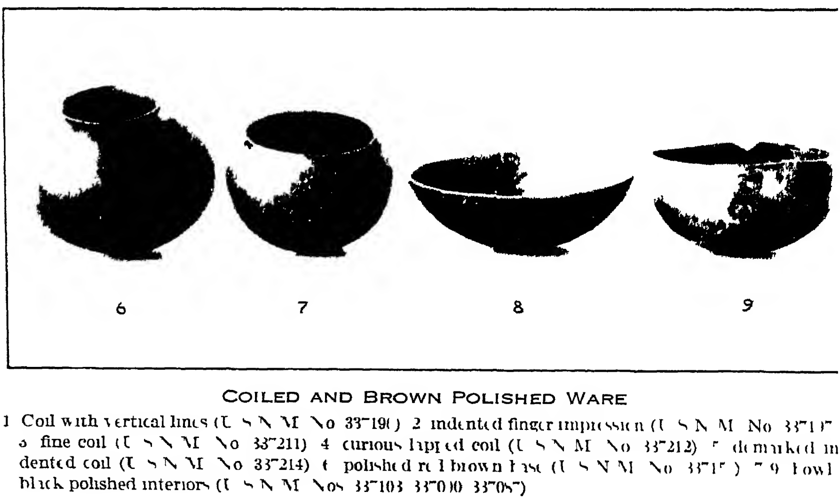


BOWLS OF RED WARE

1, Four birds on square in motion (U. S. N. M. No. 337302). 2, Buff ware, red decoration, Kayenta type (U. S. N. M. No. 337304). 3, White decoration on red (U. S. N. M. No. 337301).







COILED AND BROWN POLISHED WARE

1, Coil with vertical lines (U. S. N. M. No. 337190); 2, indented finger impression (U. S. N. M. No. 3371[illegible]); 3, fine coil (U. S. N. M. No. 337211); 4, curious lapped coil (U. S. N. M. No. 337212); 5, demarked indented coil (U. S. N. M. No. 337214); 6, polished red brown base (U. S. N. M. No. 3371[illegible]); 7-9, bowl black polished interiors (U. S. N. M. Nos. 337103, 3370[illegible]0, 3370[illegible]7).

NEW DIPTERA, OR TWO-WINGED FLIES FROM AMERICA, ASIA, AND JAVA WITH ADDITIONAL NOTES

BY

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Associate Curator, Division of Insects
United States National Museum

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NEW DIPTERA, OR TWO-WINGED FLIES, FROM AMERICA, ASIA, AND JAVA, WITH ADDITIONAL NOTES

By J. M. ALDRICH

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This paper contains descriptions of 4 new genera, 13 new species, and 1 new variety of Diptera, together with some miscellaneous notes. It constitutes a report, which for various reasons it seems desirable to publish, on an accumulation of specimens collected from many parts of the world. All the species are represented in the United States National Museum collections by type or paratype specimens.

Family CYRTIDAE

Genus OCNAEA Erichson

Eriosoma MACQUART (preoccupied), Dipteres exotiques, vol. 1, pt. 2, p. 288 (sep. p. 172), 1839.

Ocnaea ERICHSON, Entomographien, vol. 1, p. 155, 1840.—COLE, Trans. Amer. Ent. Soc., vol. 45, p. 23, 1919.

Exetasis WALKER, Insecta Saundersiana, p. 203, 1852.

Two species were originally included in *Ocnaea*, both new, *micans* from Mexico and *longicornis* from Brazil; the second was figured. Coquillett [1] designated *Ocnaea micans* as the type species. Macquart designated *Acrocera calida* Wiedemann as type of his *Eriosoma*. *Exetasis* contained originally but one species, *tumens*, new, which is therefore the type; Loew [2] placed the genus as a synonym of *Ocnaea*.

The genus has very striking characters. The proboscis is very short; the densely hairy eyes are contiguous from the mouth almost to the vertex; there is a short frontal triangle bearing the antennae; the anterior ocellus is absent; the antennae have a greatly elongated third antennal joint, curving downward, not bearing a style or arista. The venation is complete and in general not unlike that of *Tabanus*, except in a few variable details and in the regular occurrence of a cross vein in the first posterior cell at or beyond the

[1] Proc. U. S. Nat. Mus., vol. 37, p. 577, 1910.
[2] Wiener Ent. Monatsschr., vol. 1, p. 34, 1856.

tip of the discal. The third vein is not always forked near the tip. but this fork occurs in the genotype (mentioned in the note after the description of *longicornis*, which lacks it); it does not occur in the genotype of *Exetasis*. There is a marked tendency toward the development of adventitious cross veins, which apparently have very slight taxonomic value. Considerable variation exists in the apical part of the first posterior cell, which may be petiolate or closed in the margin, or partially coalesced with the second posterior by the disappearance of the last part of the fourth vein, or widely open. In drawing up a key largely from figures and descriptions, I had made considerable use of these differences, until I observed that my new species differed in the two wings of the single specimen and would run to what I had supposed were two groups of species. This discrepancy compelled me to view these differences with more caution.

The nearest related genus is *Apelleia* Bellardi.[3] The only species included was *vittata*, new, from Mexico; it has bare eyes, and this was put forward as the main difference from *Ocnaea*. Osten Sacken described in *Ocnaea* a species (*grossa*) with bare eyes, indicating that the character is not of generic value; but it seems so to me, and I therefore transfer *grossa* to *Apelleia*. I recognize the fact that great caution should be exercised in proposing new genera in the family, where great plasticity seems to exist in characters which would elsewhere be of generic or even family rank. The problem is to find constant characters, and this implies the examination of considerable series in many species—a requirement which can hardly as yet be met in any collection. It may be that *Exetasis* will ultimately be restored to rank on the absence of the fork of the third vein; it would include *tumens* Walker (genotype), *calida* Wiedemann, and *longicornis* Erichson.

In preparing the following key, I have been able to examine only *schwarzi*, *gigas*, *falcifer*, *flavipes*, and *trivittata* (all in type material); Cole's figures and those of Wiedemann, Erichson, Walker, and Osten Sacken have been of great assistance, and I have studied the descriptions closely. Nevertheless it must be considered as a preliminary effort. Cole has given a key to the five species from North America, which he had seen, in the reference cited above. I still have misgivings as to the distinctness of my *gigas* and *falcifer*, which may be a single unusually variable species.

In response to a request from me, Dr. G. Enderlein very kindly sent me notes on the types of three species in the Berlin Museum (*micans*, *longicornis*, and *lugubris*), together with excellent figures of the venation in each case.

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[3] Mem. Acad. Sci. Torino, vol. 21, p. 214, 1861 (or "Saggio di Ditt. Mess.," appendix, p. 17).

KEY TO SPECIES OF OCNAEA

1. Third antennal joint clavate — 2
   Third antennal joint of uniform width, slightly tapering — 3
2. Legs brown, knees yellow (Mexico) — micans Erichson
   Legs yellow (Texas) — loewi Cole
3. Third antennal joint with scattered hairs on upper edge (Panama) — trichocera Osten Sacken
   Third antennal joint bare — 4
4. Third vein not forked — 5
   Third vein with widely divergent anterior fork near tip, about as in *Tabanus* — 7
5. Mesonotum luteous, legs brown (Brazil) — calida Wiedemann
   Mesonotum black on disk, legs yellow — 6
6. Scutellum yellow, third antennal joint comparatively short, less than height of eye (Brazil) — tumens Walker
   Scutellum black, third antennal joint very long, exceeding height of eye (Brazil) — longicornis Erichson
7. Femora yellow — 8
   Femora more or less infuscated — 11
8. Mesonotum yellow (Texas) — auripilosa Johnson
   Mesonotum black, or with distinct dark area — 9
9. Second, third, and fourth abdominal segments reddish yellow with a decreasing row of black spots in middle (Honduras). flavipes Aldrich
   Second, third, and fourth abdominal segments with basal transverse black bands — 10
10. First posterior cell petiolate by the union of the third and fourth veins before margin; adventitious cross veins present in marginal, and first and fourth posterior cells (Texas). helluo Osten Sacken
    First posterior cell united with second near tip by the disappearance of the fourth vein near base of second cell; no adventitious cross veins (the one dividing the first posterior is not here regarded as adventitious) (Cuba) — schwarzi Cole
11. Mesonotum yellow with three broad black stripes confluent behind, the outer much abbreviated in front; scutellum dark yellow (Honduras) — trivittata, new species
    Mesonotum wholly black or blue except more or less of lateral margins; scutellum concolorous — 12
12. Abdomen metallic blue with narrow interrupted apical yellow cross bands on second, third, and fourth segments (Texas) — coerulea Cole
    Abdomen brown, hind edges of same segments indistinctly paler (Brazil) — lugubris Gerstaecker
    Abdomen without cross bands, except a broad one on second segment — 13
13. Blackish in color, with reddish third antennal joint (Ecuador). falcifer Aldrich
    Brown in color, third antennal joint almost black (Ecuador) — gigas Aldrich

OCNAEA TRIVITTATA, new species

Third vein forked at apex; on one side the fourth vein is incomplete, on the other it joins the third just beyond the middle of its last section, making the first posterior cell petiolate. Coxae brownish, femora irregularly brownish, not very dark; tibiae and tarsi yellow, apical half of last tarsal joint and the claws black; pulvilli yellow.

Male.—Head rather large, eyes with dense yellow pile; palpi and proboscis very minute, not visible; antennae reddish brown, first joint black above, third slender, longer than height of head, and longer than front tibia.

Thorax and abdomen with dense erect yellow pile, venter bare; mesonotum yellow with three broad black stripes confluent behind, rounded in front, the outer much abbreviated anteriorly; pleurae brown, both spiracles white; scutellum brownish yellow; calypters roughened, margin brownish yellow with pale fringe.

Abdomen shining blackish brown, first four segments with whitish hind margin of uniform width, that on first segment narrow, on the following ones conspicuous, not widening laterally except at extreme edge, where they include half the segment; they extend across venter at the width which they assume at the edge. Fifth segment with narrow pale hind border, sixth with only a lateral pale spot.

Wings small; the cross vein in the first posterior cell is more than its length beyond the discal; no indications of other unusual cross veins.

Length, 9.5 mm.

Type.—Male, U.S.N.M. No. 43480, collected by Dr. J. Bequaert at Sangrelaya, Honduras, March 13, 1924, and presented by him to the National Museum.

Remarks.—Described from one male, the type. This is the only species of *Ocnaea* with distinct thoracic stripes.

Family DOLICHOPODIDAE

COLLINELLULA, new genus

Very minute. Posterior half of mesonotum depressed. Antennae minute, third joint rounded, with apical bare arista; first antennal joint bare; head concave behind; proboscis and palpi small. Ocellars large, proclinate, divergent, situated high up; one outer vertical, and one frontal near eye. Face narrow in female, the eyes almost touching near epistoma; in male the eyes are contiguous below the antennae to the mouth. Thorax with two rows of rather strong acrostichals; two dorsocentrals on each side near scutellum, the row

continuing forward as coarse setules, not much larger than the acrostichals; scutellum with a single pair of bristles, far apart. No bristle on outer side of hind coxa. Male with globose and somewhat exserted hypopygium, the abdomen rather cylindrical. Wing of male (pl. 1, fig. 2) with distorted venation; in the female (pl. 1, fig. 3) the first vein is short, the second parallel with costa nearly to tip, third vein ending just at tip, fourth diverging moderately, ending as far from tip of third as the second does, or very little farther; hind cross vein behind the center of the wing, a little shorter than last segment of fifth vein; basal cells and sixth vein absent.

Related to *Achalcus*, but that has five pairs of acrostichals, two before the suture. In head structure the new genus is very much like *Thrypticus*, but that has the venation quite different, the hind cross vein small and retracted, and the anterior part of the thorax is peculiarly bulging and prominent above. *Thrypticus* also has better developed dorsocentrals.

Named in honor of J. E. Collin.

Genotype.—*Collinellula magistri*, new species.

COLLINELLULA MAGISTRI, new species

PLATE 1, FIGURES 2-4

Male.—Very minute; dark blue-green; legs, antennae, and palpi black. Venation as figured, which alone would make the species instantly recognizable. The groups of long hairs give under low power the effect of slight clouds in the wing. Front tarsi complicated in structure; the first joint rather thick and short, widened apically; the second shorter and paler, forming an irregular collar; third somewhat like the second but excised below, the excision partly closed by a transverse plate, and the upper side of the segment with a striking spine at apex; fourth segment very short and tapering; fifth segment as long as the preceding three, very narrow at base, rapidly widening into a triangular flat shape, with dense fine hair and the usual claws and pulvilli. The tarsus is described from a specimen mounted in balsam, its small size making the details practically impossible to see otherwise. Abdomen deep green, the globose genitalia shown in posterior view and spread out (pl. 1, fig. 4), where the rest of the structures are shown in the side view, considerably pressed down. The two median ventral organs anterior to the hypopygium are especially noteworthy. Middle femora with a long bristle at base below.

Length, 1.2 mm.

Female.—Like the male, but the wings and tarsi are normal, and the eyes do not come entirely together below the antennae, except just at the mouth.

Length, 1.1 mm.

Paratypes.—Male and female, U.S.N.M. No. 43658.

Remarks.—Described from 11 males and 9 females, all collected at Taughannock Falls, near Ithaca, N. Y., on August 19, 1928, by J. E. Collin, of Newmarket, England; and 1 female collected by me at Washington, D. C., on July 1, 1920. In the specific name I mean to celebrate the ability of Mr. Collin as a collector.[8a]

Four males and three females of the Ithaca material are retained in the National Museum, a gift from Mr. Collin; the rest of the series, including the type, is returned to him.

A single female in the National Museum, collected by me at La Fayette, Ind., August 24, 1916, seems to belong to another species of this genus.

Genus LEPTOCERA Olivier

Leptocera Olivier, Mem. Soc. Agr. Dept. Seine, vol. 16, p. 16, 1813.—Coquillett. Proc. U. S. Nat. Mus., vol. 37, p. 559, 1910.

LEPTOCERA (LIMOSINA) OPACA, new species

Head, thorax, and abdomen black. Front opaque, two-thirds the width of head, with two pairs of convergent bristles back of vertex (one outside the other); a small divergent pair just behind ocelli; outer verticals reclinate, inner large and convergent but not decussate; ocellars proclinate and divergent; two divergent orbitals each side; three pairs convergent bordering middle region, lowest just above suture. Antennae black, decidedly divergent, separated by the triangular lunule; arista long and slender, pubescent. Face shining black, concave, epistoma protruding, narrow, prelabrum visible but not prominent; a large bristle laterally below end of suture at edge of mouth, directed forward. Cheek at narrowest hardly one-half the eye height, bare except a few hairs below. Mouth large. Mesonotum opaque, nearly circular, with 14 regular rows of hairs; suture not distinguishable. Thoracic bristles as follows: Dorsocentral, 1; prescutellar, 1 small; humeral, 1; notopleural, 1; presutural, 1; postalar, 1; mesopleural, 0; sternopleural, 1; scutellum flat, moderately long, bare, with two pairs of marginals. Halteres brownish yellow. Abdomen opaque black. Legs black. Coxae and trochanters yellow, the former more brownish; tarsi brownish, middle and hind often yellowish. Mid tibia of female with one smallish ventral bristle on middle and large apical on same side (both lacking in male), also two widely spaced bristles in both sexes on anterior dorsal surface and two beyond middle and nearly side by side on posterodorsal. Wings with slight infuscation, moderately rounded; costa without striking bristles, the segment between tips of first and second veins equal to the following; cross veins strikingly approx-

[8a] Dr. G. Enderlein, of Berlin, Germany, also distinguished himself as a collector by capturing both sexes of the same fly on the same occasion, as I learned from a letter received after the galley proofs of the present paper had been corrected.

imated, their distance apart on fourth vein generally less than half the length of hind cross vein; third vein almost imperceptibly curved forward toward tip, ending only a little before tip of wing; costa extending distinctly beyond it, fourth and fifth evanescent from slightly beyond hind cross vein.

Length, 1.5–1.6 mm.

Type.—Male, U. S. N. M. No. 42847.

Remarks.—Described from 16 mounted and 14 alcoholic specimens, collected February 2, 1930, in a dahlia cellar at Fort Collins, Colorado, and sent to the Museum by Sam C. McCampbell, Deputy State Entomologist.

The species is exceedingly like *heteroneura* Haliday of Europe, which I have not seen. Duda's full description of *heteroneura*[4] seems to leave few differences to note. It has the second abdominal segment in the male much elongated, but ours has it hardly any longer than the third or fourth. In the European species the face is dirty yellow; in ours it is black. These are the chief differences I see. The wing of *opaca* agrees with Duda's figure.

This species would go in the subgenus *Scotophilella* Duda.[5] This subgenus, however, is a synonym of *Limosina* Macquart,[6] as already pointed out by Richards.[7]

Family OTITIDAE

(ORTALIDAE of authors)

The generic name *Ortalis* being preoccupied in birds, and in fact in common use there, the family should be based upon the still older genus *Otites* Latreille[8] (type *Musca formosa* Panzer). This genus belongs to the subfamily Ortalinae of authors, hence the change to Otitinae does not affect the other subfamilies.

DYSCRASIS, new genus

Belongs in subfamily Pterocallinae, but is widely different from any known genus. The presence of five pairs of well-developed dorsocentrals, and of the same number of equally large acrostichals, one pair of each being before the suture, separates the genus from all known to me. Numerous venational peculiarities, which are impressively shown in Plate 1, Figure 1, also emphasize the distinctness of this form. I was at a loss to place it in any subfamily, and referred a specimen to Professor Hendel, whose extensive publica-

[4] Abh. K. K. Ges. Wien, vol. 10, no. 1, p. 188, 1918.
[5] Abh. zool.-bot. Ges., vol. 10, p. 34, 1918.
[6] Histoire naturelle des insectes, Diptères, vol. 2, p. 271, 1835.
[7] Proc. Zool. Soc. London, 1930, p. 291.
[8] Histoire naturelle, générale et particulière des crustacés et des insectes, vol. 14, p. 383, 1805.

tions in the group are well known; he places it as a peculiar form of the above subfamily.

Head broad and short (flattened from before); frons wider than one eye, with parallel sides, flat; face receding below antennae, slightly protruding at epistoma, without antennal grooves; antennae with both basal joints very short, third oval, shorter than face, with arista microscopically pubescent. Proboscis short, palpi of ordinary size, flat. Cheek a little more than half the eye height. Postvertical bristles divergent; other head bristles are inner and outer verticals; two fronto-orbitals, reclinate, the anterior halfway between inner vertical and lunule; and the usual ocellars, which are of good size. Ocellar triangle small.

Thorax narrower anteriorly than the head, almost bare of small hair, with the following bristles: Acrostichal, 1,4; dorsocentral, 1,4; prothoracic, 0; humeral, 1; notopleural, 2; supraalar, 2; intraalar, 0; postalar, 2 (the outer might be taken for a low supraalar, and the inner for a high one); mesopleural, 2 small on hind edge; sternopleural, 1; scutellars, 2 pairs. Scutellum swollen, polished.

Abdomen broader than thorax, sixth joint in female (base of ovipositor) broad, flat, shining.

Legs not elongated, without noticeable bristles, except a double posterodorsal and a single longer posteroventral row on anterior femora, and a row of small ones on middle of anterior side of mid femora.

Wings (pl. 1, fig. 1) with striking pattern somewhat resembling that of the trypetid *Ceratitis capitata* Wiedemann. Costa without a break; costal cell very wide, the auxiliary vein sinuous, ending far before tip of first vein; first vein long, hairy above on apical half; second and third veins converging beyond small cross vein, then diverging; anal cell with a long acute extension reaching two-thirds of the way to the wing margin, and narrowed at its base.

Genotype.—Dyscrasis hendeli, new species.

DYSCRASIS HENDELI, new species

Male.—Frons gray pollinose, its lower half or less shining brown; ocellar triangle also pollinose. Face except immediately below the antennae white in ground color with very thin white pollen; cheeks and lower back of head the same but not quite so white. Thorax with two pairs of large polished black spots, above the notopleural area and wing, one before and the other behind the suture; these spots show a little velvety in some lights on their outer edge. Scutellum swollen and polished black. Remainder of dorsal region with thin gray pollen, except a small, opaque, black semicircle just before the scutellum and traces of dark spots at the bases of the

bristles. Upper half of pleura and notopleural region with white pollen forming a sharply limited band, which passes around the metanotum below the small infrascutellum; lower half or a little less of the pleura brown. Abdomen shining black, the dorsum of the second segment, however, white pollinose, and a band of white pollen on hind edge of third and fourth segments, widest on middle of third segment. Legs brownish yellow, the femora nearly black and tarsi yellow, except near tips, where they become brownish. Wings as shown in figure and as described under the genus; the color pattern is brown, but yellow in a considerable area around the anterior cross vein.

Length, 3.5–3.7 mm.

Female.—Like the male, but the fifth segment is white pollinose dorsally for about two-thirds of its length from the base.

Length, 4.2 to 5 mm.

Type.—Male, U.S.N.M. No. 43575.

Remarks.—Described from 17 specimens of both sexes: Eight specimens, including type and allotype, are from Dallas, Tex., collected by F. C. Bishopp, the dates being March 29, 1907; March 17 and 20, 1908; and May 30, 1908; one male, Uvalde, Tex., in trap, November 16, 1915 (Bishopp No. 5672); one male and three females, Matamoras, Mexico, in traps (T. R. Stephens); one male, Mercedes, Tex., in trap, August 26, 1931 (W. R. Heard); one male, San Benito, Tex., on office window, May 26, 1930 (L. F. Greer); one female, Allen, Tex., August 14, 1931 (F. O. Swan); one female, Texas, no other data.

Family RHOPALOMERIDAE

This family has been revised by Professor Lindner in Deutsche Entomologische Zeitschrift, 1930, pp. 122–137.

Genus KRÖBERIA Lindner

Kröberia LINDNER, Deutsche Ent. Zeitschr., 1930, p. 127.

The only species known is *fuliginosa* Lindner from southern Brazil, described in the same place. The arista is bare, the scutellum not prolonged into a blunt, shining, knoblike tip, but rounded, flat above; front flat, not concave, covered with hairs except on the ocellar triangle, which extends narrowly forward to the lunule; one or two small orbitals present; anterior edge of front somewhat overhanging the antennae in a transverse rim. Auxiliary vein well developed; fourth vein ending just before tip of wing, rather close to third.

KRÖBERIA FLORIDENSIS, new species

Dark brown, legs yellowish brown, basal and apical third of tibiae and tarsi from tip of first joint blackish. Differs from *fuliginosa* in having the scutellum opaque brown with pale pollinose border; the hind femora only moderately thickened, with only a few bristles above; and the hind tibiae only slightly flattened.

Male.—Front black in ground color, with thin pale pollen, ocellar triangle more densely pollinose; a silvery pollinose spot between eye and third antennal joint; face dark yellow, the protuberance sometimes blackened, the epistoma below it transversely wrinkled; cheek brown, wrinkled, nearly as high as the eye, with pale hair. Mesonotum black, with five distinct pale pollinose stripes ending at scutellum; mesopleurae with pale pollen, covered with small dark dots where the hairs arise, but these do not extend upon the portion below the spiracle. Chaetotaxy: Acrostichal, 1 (prescutellar); dorsocentral, 1 or 2 (far back); humeral, 1; notopleural, 2; presutural, 1; supraalar, 1; postalar, 2; intraalar, 1 (before the inner postalar); scutellar, 2 pairs (a third in one male and an odd one in a female); mesopleural, 2 or 3; sternopleural, 1. Most of these bristles are quite small. Abdomen blackish, dorsum opaque, second and following segments with interrupted band of pale pollen on posterior half or more, widening toward sides to include whole length of segment, most distinct from behind. Legs as described; hind femur with anterodorsal row of bristles from base nearly to tip, and two short rows near tip, none of striking size. Wings rather uniformly pale brownish. Knob of halteres very pale yellow.

Length, 6–6.6 mm.

Female.—Abdomen with pale pollinose stripe on each side, central region opaque dark brown; sixth and seventh segments shining black, the latter becoming dark yellow toward tip.

Length, 7 to 8 mm.

Type.—Male, U.S.N.M. No. 43761.

Remarks.—Described from two males and four females, reared from rotten wood of *Sabal palmetto* in Putnam County, Fla., by Mark Dodd, February 21, 1931; and one female reared by D. J. Nicholson from a larva found in decayed wood of *Sabal minor*, 6 inches under water, 1½ miles east of Fort Christmas, Fla., emerged March 25, 1931.

The discovery of this species in northern Florida, only about 70 miles from the Georgia line, extends the known range of the family in a remarkable way. Lindner recognizes about 13 species in 6 genera. All these are distinctly tropical, and nearly all range southward from the northern limits of South America to Paraguay

and northern Argentina. None have been reported from the West Indies, nor from the United States.

All the references to occurrence from Panama north are the following:

Rhinotora diversa Giglio-Tos was described from Tuxpango, Mexico.

Rhopalomera xanthops Williston was described from Yucatan; the collector being Gaumer, the species was probably taken near Merida.

Rhopalomera femorata Fabricius, described from South America, is reported by Lindner from Guatemala and Mexico.

Willistoniella pleuropunctata Wiedemann, described from South America, is reported from Playa Vicente, Mexico, by Giglio-Tos; from the Volcano Colima, Mexico, by Lindner; and I have identified it from Corozal, Canal Zone, where Mr. Zetek bred it from trunk of coconut palm.

Genus SCATOPHAGA Meigen

Scatophaga MEIGEN, Illiger's Mag. für Insekt., vol. 2, p. 277, 1803.

SCATOPHAGA GIGANTEA, new species

A very large species, the male with dense long fulvous hair on abdomen, legs, and pleurae; hair on mosonotum black.

Male.—Front prominent, angular at antennae; eye oblique; cheek high, especially behind, about equal to height of eye; back of head very bulging; palpi a little shorter than proboscis. Front broad, with a narrow black orbit covered with yellow pollen; frontal stripe almost half the width of the head, deep red, the middle portion blackish and having a bluish reflection; parafacial and anterior half of cheek red with bluish reflections; antennae black, third joint hardly twice the second and reaching five-sixths of the way to principal vibrissae; arista pubescent; palpi reddish yellow, with long black hairs below from near base to tip; proboscis black, its principal segment shorter than height of head. Back of head with black hair on upper half or about to lower edge of eye, the rest covered with the same long fulvous pile as the pleurae and femora. Inner vertical bristles long, ocellars slightly shorter, the row of frontals still shorter, all slender. About a dozen slender bristles in a row from epistoma to and a little above the main vibrissa.

Thorax black with dense fulvous pollen above and on the scutellum and pleurae; mesonotum with erect long delicate black hair and a few bristles; the most distinct bristles are the posterior notopleural; three supraalar; on intraalar, far back; two postalar; and

the posterior pair of dorsocentral, far apart. Scutellum with three pairs. Sternopleural with one posterior. The long fulvous pile covers the mesopleura, propleura, and sternopleura, leaving the pteropleura and all behind it bare. Calypters with fulvous rim and marginal hairs, which are very long on the fold.

Abdomen black in ground color, with very striking long dense fulvous hair, which seems even more brightly fulvous than that of the sides of the body and the femora. This dense covering extends over the sides of the abdomen and even somewhat underneath, so that no bare area below is visible.

Legs reddish yellow, the coxae and basal three-fourths or more of femora black. Coxae with dense long fulvous pile to the outer hind side of the middle ones, this area and all the outer side of the hind ones bare; femora and tibiae with the same pile as the pleurae, but it is mainly black close to the apices of the femora, and considerably mixed with black on the extensor side of all the tibiae. Tarsi with comparatively short black hair above, about as long as the depth of the segment. Pulvilli brown, claws black. The middle tibia has two spines on the anterodorsal side, three or four on the posterodorsal, two on the posteroventral, and one on the anteroventral, not including the apicals. The hind tibiae have three spines on the anterodorsal and two on the posterodorsal. None of the femora have spines.

The wings are distinctly yellow, more intense near base.

Length, 12–15 mm.

Female.—The characteristic red color of front, parafacials, and cheek as in male; the pile, which is so striking in the male, is reduced to insignificant size, though present. The mesonotum is deep fulvous, with the following chaetotaxy: Acrostichal, 4 delicate rows of hairs; dorsocentral, 2, 3; humeral, 2; presutural, 1; notopleural, 2; supraalar, 2; intraalar, 1 far back; postalar, 2; sternopleural, 0, 1; scutellum, with 2 pairs marginal. Abdomen depressed, with dense gray pollen, seventh segment wholly shining, except hind edge, which is notched in the middle above. Legs reddish yellow, only the front femora a little black above. No bristles on front femora; middles ones with two on front side beyond middle and two near together near tip on hind side; hind femora with irregular row of about six small on anterodorsal side. Front tibiae with two bristles on front side; middle tibiae with two anterodorsal, two posterodorsal, and one anteroventral; hind tibiae with three anterodorsal and posterodorsal.

Length, 9 mm.

Type.—Male, U.S.N.M. No. 43692, from Yu Long Gong, Tibet, August 1, 1923. Allotype from same lot.

Remarks.—Described from 63 males and 22 females, all collected by Dr. D. C. Graham, in the high country of western China along the Tibet border and in the edge of Tibet. Ten males and one female were collected August 1, 1923, at Yu Long Gong, Tibet, near Tatsienlu, altitude 12,000 feet; 13 males and 3 females at the same place, August 12, 1930; 12 males 9 miles south of Tatsienlu, June 26 and 27, 1923, altitude 8,500 to 13,000 feet; 12 males and 1 female at Yu Long Si, July 26–28, 1930, altitude 14,000 to 15,900 feet; 9 males and 1 female in Yu Long Si Gorge, 13,000 to 15,000 feet, no date; and 7 males and 16 females near Wa Hu Pass, Tibet, August 6 and 7, 1930, altitude 14,000 to 16,000 feet.

In chaetotaxy the species resembles *Scatophaga vulpina* Coquillett, from Point Barrow, Alaska. It is the largest species of the genus as far as I know. The lot first cited was labeled, "Fond of cowdung."

SCATOPHAGA GIGANTEA OBSCURA, new variety

A series of males differ from typical *gigantea* in being smaller, the pollen of the dorsum dull brown, pile of pleurae and abdomen shorter and darker, that of the femora and tibiae almost wholly black, and shorter than in the typical form. The appearance is so different that it is hard to believe the relationship so close as it appears on closer study. The head structure is the same, with the characteristic deep red color of front and face, but the pale pile of the back of the cheek is much less conspicuous. I am not able to recognize a corresponding series of females, as these males approach the typical females in their appearance, except for having in general a darker color of the thoracic pollen.

Type.—Male, U.S.N.M. No. 43693, from Yu Long Gong, Tibet.

Length, 8 to 9 mm.

Remarks.—Described from 14 males collected with typical *gigantea* as above cited. Ten are from Yu Long Gong, three from Wa Hu Pass, and one from Yu Long Si.

SCATOPHAGA AMPLIPENNIS Portschinsky

Scatophaga amplipennis PORTSCHINSKY, Horae Soc. Ent. Ross., vol. 21, p. 199, 1887.

Portschinsky's description is so brief that it seems worth while to give a fuller one, as a long series is available from Doctor Graham's collecting.

A slender blackish species with inconspicuous pile, but with very long and broad wings, which are uniformly dark brown in color. It agrees with *Scatophaga scybalaria* Linnaeus in having the attach-

ment of the abdomen distinctly elevated above the hind coxae, so that the sclerites above the latter (metathoracic epimerit of Hendel) are completely united on the middle line, not separated by a membranous portion as in other species. It differs from *scybalaria* in having the arista pubescent, not pilose, in much darker color, and in other respects.

Male.—Black in ground color, including femora; tibiae reddish yellow, tarsi brownish yellow; palpi yellow with brownish apices; frontal stripe very dark red with a glaucous reflection. Head dark brown above, the frontal stripe narrowed upward, the parafrontal portions wide, elevated in middle, with dense long slender bristles, of which about half a dozen of the upper series turn out over the eye, the lower ones being mesially directed. Parafacials reddish on upper half along facial ridges, elsewhere with brown pollen. Vibrissal region with dense row of bristles. Antennae wholly black, third joint less than twice the second, arista black, densely pubescent. Cheek two-thirds as high as eye, which has a somewhat diagonal position, the cheek with upturned slender hairs below, its posterior half with long and mostly yellow hairs. Palpi infuscated and with many black hairs beyond the middle, just before the middle the hairs are yellow. Thorax with dark pollen and a median glaucous stripe reaching the scutellum, on each side of this a partly double blackish, subshining stripe; scutellum glaucous on middle, connecting with the thoracic stripe. Chaetotaxy: Acrostichal, only fine, erect hairs all the way; dorsocentral, 2 hairlike anteriorly, about 3 bristles posteriorly, the hindmost gradually larger; notopleural, 2; presutural, 1; supraalar, 2; postalar, 2; intraalar, 0; sternopleural, 0, 1; scutellum, with 2 lateral pairs and an equally long apical pair close together. Pleurae with rather dense but slender long brownish hair. Calypters brown, smallish, with fringe of dark yellow hair. Pteropleural and all behind the sternopleura bare. Halteres with brown knob.

Abdomen narrow, not much deflexed, shining brownish black, covered above and on sides with dense, erect, but rather short yellow pile, which is more or less mixed with black close to tip; this pile seems to cover the under side also.

Legs with erect but not very long pile, which varies on the femora from black to brown and a considerable admixture of yellow; front tibiae with long black pile on outer side, middle and hind ones with the same standing out all round; front tarsi with the three intermediate joints short, of equal length; pulvilli blackish, claws black; middle tibia with two anterodorsal spines beyond middle, two posterodorsal, one flexor far down toward tip; hind tibia with three anterodorsal, three posterodorsal (one near base).

Wings strikingly long and wide, and of uniform dark brown color, only the anterior part near base gradually a little yellowish. In a male measuring 9.5 mm, the wings measured 12.5 long and 5 wide at middle. First posterior cell not narrowed at tip, hind cross vein bisinuate.

Length, 7.5–10 mm.

Female.—Wing not so strikingly enlarged; in a specimen 8 mm long the wing measured 8 mm long and 2.5 mm wide; wing color a little paler than in male; abdomen depressed as in most species and much wider across middle than in the male. Front tibia with two hairlike extensor bristles; middle tibia with two anterodorsal spines; three posterodorsal; one flexor; hind tibia with three anterodorsal; three posterodorsal.

Length, 6.4–8 mm.

Remarks.—Redescribed from 35 males and 13 females, collected by Dr. David C. Graham in the high altitudes along the Tibet-China boundary. Four males were collected in Yellow Dragon Gorge near Song-Pan, altitude 12,000 to 14,000 feet, in the summer of 1924; all the others were collected at Yu Long Si, near Tatsienlu, July 26–28, 1930, altitude 14,000 to 15,900 feet.

Genus SARCOPHAGA Meigen

Sarcophaga Meigen, Systematische Beschreibung, vol. 5, p. 14, 1826.

SARCOPHAGA (BLAESOXIPHA) VALANGAE, new species

Figure 1

Male.—First vein bare, posterior dorsocentrals generally three, but a small or even a normal additional one may occur as the second behind the suture; without villous hairs on inner side of hind tibia; genital segments dull black or dark brown.

Front 0.18 of head width, at narrowest, above middle (four measured 0.18, 0.18, 0.19, 0.18); ocellars normal, proclinate; outer vertical not differentiated; two upper frontals reclinate but the second pair partly convergent; eight other frontals in row, which extends to near tip of second antennal joint and diverges toward eye; parafrontals narrow, brownish above, subsilvery below; frontal stripe brown; parafacials subsilvery, a changeable dark spot in the pollen at lowest frontals, the parafacial hairs rather numerous and bristly below; facial ridges broadly curved outward in middle of the face, converging markedly below, with small irregular setules extending halfway up; middle of face blackish; cheek two-fifths of eye height, with black hair except on hind edge; back of head with black hair, only a little pale about neck and below. Palpi black, proboscis ordinary. Antennae black; third joint one and one-half times the

second; arista with rather short plumosity for less than half its length.

Thorax gray, with three black stripes and a partial one above the wing extending a little before the suture, the median stripe extending nearly to tip of scutellum; at least three pairs of large and somewhat irregular anterior and four pairs posterior acrostichals; sternopleural 3; scutellum with three pairs lateral, one discal, the apical pair quite large, subdepressed, decussate. Hind calypter distinctly brownish.

Abdomen gray with medium black stripe becoming slender on fourth segment, and one less distinct lateral black stripe each side, changeable on third segment and ending at middle of fourth; a pair of median marginals on second segment, marginal row on third and fourth. Genital segments brownish, small; genitalia as in Figure 1. Forceps flattened behind, brown basally; outer forceps (accessory plate of Parker) rather large for a *Sarcophaga*, brown basally; penis very small. In the figure the anterior and posterior claspers change places, crossing each other at base. Fifth sternite deeply cleft, without striking characters.

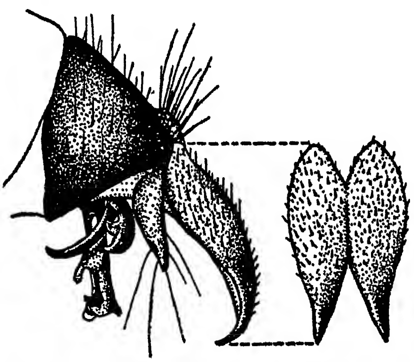

FIGURE 1.—*Sarcophaga* (*Blaesoxipha*) *valangae*, new species. Side view of male genitalia with forceps from behind. (Drawn by David G. Hall)

Legs black, front tibia with one bristle on hind side; middle tibia with one on outer front.

Wings subhyaline, costal segment before first vein equal to the one beyond second; third vein with bristles extending more than halfway to anterior cross vein.

Length, 7 mm.

Female.—Much grayer, the black thoracic stripes narrower and the median one hardly visible on scutellum. Front near vertex 0.29 of head width (four measured 0.29, 0.3, 0.28, 0.28); parafacials with fewer setules; abdomen more tessellated, median stripe much less distinct, the lateral hardly noticeable. Second segment without median marginals, at most with depressed bristly hairs. Terminal ventral sclerite yellowish, a little elongated, tapering, slightly curved downward. Posterior dorsocentrals uniformly three.

Length, 6 mm.

Type.—Male, U.S.N.M. No. 43689.

Remarks.—Described from five males and 15 females, reared from the locust *Valanga nigricornis* Burmeister, at Gedangan, central Java, by F. Verbeek, December, 1929, and sent to the National Museum by Dr. S. Leefmans, of Buitenzorg, to whom a pair of paratypes are returned.

The species is very similar to those that in Europe have been regarded as belonging to the genus *Blaesoxipha.* The male is readily distinguishable from all European forms known to me, in having the forceps much broader toward the base and the anterior claspers with a lobe on the front near the middle.

Genus LESKIOMIMA Brauer and Bergenstamm

Leskiomima BRAUER and BERGENSTAMM, Zweiflügler des kaiserl. Museums zu Wien, pt. 5, p. 372, 1891 (Denkschr. kaiserl. Akad. Wiss., vol. 58).

LESKIOMIMA JAYNESI, new species

A slender yellowish fly, differing from the type species *tenera* in having only one to three coarse hairs at middle of first vein instead of a full series on all its length becoming more densely placed near tip. Palpi of ordinary size; proboscis (last joint) long and slender (one and one-third times the head height), curved downward, with small labella. Eyes bare. Face slightly receding, epistoma not prominent. Ocellars present, proclinate and divergent; a single pair of large verticals; two upper frontals reclinate, the uppermost, however, very small, the lowest at middle of second antennal joint; parafacial about as wide as third antennal joint. Cheek two-fifths the eye height. Front in both sexes wide, about 0.35 of head width, and with proclinate orbitals in both; pollen of head mostly white, but not silvery. Antennae red, third joint blackened on apical two-thirds; second joint about half the third. Arista black, strongly pubescent. Mesonotum mostly black in ground color, with yellowish pollen, forming indistinct stripes. Acrostichal, 2, 1 (none just before suture); dorsocentral, 2, 3; humeral, 2; posthumeral, 1; presutural, 1; notopleural, 2; supraalar, 2 (hind small); intraalar, 2; postalar, 2; sternopleural, 2, 1; scutellum, with 1 lateral and 1 long, depressed, parallel apical. Pleurae yellow in ground color. Abdomen yellow, shining, with distinct narrow basal band of pale pollen on segments 2 to 4; no median marginals on first segment, a pair on second, marginal row on third and fourth; no discals even on fourth. Legs yellow, tarsi black. Wings with yellowish tinge, not at all elongated; fourth vein with rounded oblique bend ending not very far before tip. Costal segment before tip of first vein, considerably shorter than that between tips of second and third; hind cross vein straight and suberect.

Male with small claws and pulvilli; genitalia yellow; a small blackish spot at hind edge of third and fourth abdominal segments.

Length of male, 5.5 mm; of female, 5.6–7 mm.

Type.—Male, U.S.N.M. No. 43062.

Remarks.—Described from 3 males and 10 females, all but one of which were reared from the sugarcane borer, *Diatraea saccharalis* Fabricius, at Tucuman, Argentina. Eleven were reared by H. A. Jaynes and one by H. E. Box. The other specimen was collected by H. H. Smith at "Piedras B.," Brazil, in April; it belongs to the collection of the American Museum of Natural History, to which it is returned.

SCHISTOCHILUS, new genus

Runs to *Atractochaeta* Brauer and Bergenstamm in Stein's 1924 "Key to the Central European Tachinidae,"[9] but differs in numerous characters. Eyes bare, head in profile almost triangular, the length at vibrissae being less than one-half of that at antennae. Front long, almost horizontal, in male a little more than one-third the head width; face much receding, longer than front; third antennal joint elongated, four times the second, its upper edge straight, lower rounded forward at the apex, the sharp tip in line with upper edge. Parafacial bare, as wide as third antennal joint; facial ridges bristly on lower third. Clypeus deeply depressed, forming a single groove for the reception of the antennae, which are out of sight in profile when depressed; the groove continues to the mouth through epistoma. Arista bare, shorter than the third antennal joint, very thick and blunt, the terminal joint shorter than the preceding one. Proboscis short and small, palpi rather small. Cheek two-fifths of eye height. Outer vertical small, inner large, not decussate. Ocellars of ordinary size, proclinate and diverging. Frontals in a single row, one upper reclinate, the lowest at about the middle of the second antennal joint. One proclinate orbital in male. Prosternum with a row of black setules on each side, propleura bare. Scutellum with two pairs of laterals, the apicals small, depressed, not decussate; postscutellum well developed, but joined rather closely to the scutellum so that the transverse groove below it is much deeper than the one above. Abdomen of ordinary length, wider beyond the middle than the thorax, no discal bristles. First vein of wing bare, third with a single bristle at base. First basal cell narrow, the anterior cross vein short; apical cell widening uniformly to bend, which is rectangular and slightly rounded; apical cross vein erect, joining third vein before the tip, the petiole more than one-third as long as the cross vein and ending far before wing tip. Squamae bare, rounded, not very large.

Genotype.—*Schistochilus aristatum*, new species.[10]

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[9] Arch. für Naturg., vol. 90A, p. 19, 1924.

[10] The genus is of neuter gender, derived from the Greek *cheilos* (lip).

SCHISTOCHILUS ARISTATUM, new species

Color black, mostly gray-pollinose.

Male.—Frontal stripe brownish toward arista and the same color extending vaguely down along the edge of the lunule. Pollen of parafrontals and parafacials and posterior orbit dull gray. Palpi and basal joints of antennae dark yellow. Thorax black, with gray pollen, leaving two slender submedian stripes interrupted at the suture, an indistinct wider interrupted outer stripe. Chaetotaxy: Acrostichal, 2, 4; dorsocentral, 3, 4 (the posterior may be only 3); humeral, 2; notopleural, 2; posthumeral, 1 (inner); presutural, 1; supraalar, 2; intraalar, apparently 0; postalar, 2; sternopleural, 1, 1; pteropleural small. Scutellum black at base and margin. Abdomen shining black, with basal gray-pollinose bands on second to fourth segments, narrowed in middle on the first and covering about one-third of the segment except on the fourth where in certain lights the pollen extends almost to the tip; first and second segments without median marginals; third with a depressed pair; fourth with a row at apex of varying sizes. Genitalia small, of ordinary structure, the outer forceps almost as long as the inner. Wing quite distinctly infuscated, the color following the veins broadly, leaving a subhyaline spot in the middle of the apical cell and the margin irregularly of the same color. Base of wing distinctly paler. Squama white. Costal spine small but distinct. The costal segment before tip of second vein about one and one-third times as long as the one beyond it. Hind cross vein concave outward, joining fourth vein barely beyond middle between small cross vein and bend. Legs black; claws and pulvilli not at all elongated; middle tibia with a single bristle on anterodorsal side and one on ventral; hind tibia with a single sparse row of bristles of varying size on anterodorsal side.

Length, 5.8 mm.

Type.—Male, U. S. N. M. No. 43690.

Remarks.—Described from three males, reared from *Diatraea striatalis* Snellen, at Pasoeroean, Java, April, 1931, by Dr. P. C. Hart, received from Dr. S. Leefmans, to whom one paratype is returned.

I am unable to find a genus more nearly related to this than *Atractochaeta*, from which it differs markedly in having the deep facial groove for the antennae, the face more receding, apical cross vein more erect, and first vein bare and third with only a single setule, as well as in minor characters.

Genus ZENILLIA Robineau-Desvoidy

Zenillia ROBINEAU-DESVOIDY, Essai sur les Myodaires, p. 152, 1830.—ALDRICH and WEBBER, Proc. U. S. Nat. Mus., vol. 63, art. 17, p. 7, 1924.

ZENILLIA PALPALIS, new species

FIGURE 2

Black with ochraceous pollen on the head, thorax, and abdomen.

Female.—Head 0.27 to 0.31 of the head width; the frontal stripe velvet brown, as wide as one parafrontal; parafrontal, parafacial, and posterior orbit with almost golden yellow pollen, that of the face and cheek gray, with a slight tinge of yellow; front somewhat prominent at the insertion of the antennae, forming a slightly oblique angle with the face, the frontal profile and the facial of about the same length. Parafacial at middle as wide as third antennal joint, facial ridges with only three or four hairs above the vibrissae, which are far apart at the oral margin. Cheek one-fifth the eye height. Antennae black, tip of second joint reddish, third joint long and slender, fully four times the second, rounded at tip, reaching almost to vibrissae. Arista rather long and slender, slightly thickened on basal third. Palpi (fig. 2) considerably swollen, with a very distinct and striking pocketlike depression or hole on the outer side just before the tip, which is the same in all the specimens. Inner verticals large, outer much smaller; ocellars of good size; two upper frontals reclinate, the remaining in a single row diverging below toward orbit, reaching to the base of third joint; the usual two proclinate orbitals; parafrontal with only inconspicuous hairs besides the bristles. Mesonotum covered with yellowish pollen, which forms principally three stripes on the sides and middle, leaving a rather heavy black stripe on each side, which is divided anteriorly, the inner and narrower portion extending to the neck. Scutellum with yellow pollen. Thoracic bristles rather stout. Chaetotaxy as follows: Acrostichal, 4, 3; dorsocentral, 3, 4; humeral, 4; notopleural, 2; posthumeral, 3; presutural, 2 (the inner large); supraalar, 3; intraalar, 3; postalar, 3 (the middle one large, the others small); sternopleural, 2, 1; pteropleural small. Scutellum with 3 pairs lateral, 1 discal, the apicals slender and upturned, rather long. Propleura bare, prosternum setose, postalar declivity bare, no infrasquamal setules. Scutellum densely covered with coarse erect rather short hairs. Abdomen largely shining black, the yellow pollen forming basal bands on the second and third segments, which are wide at the side and prolonged posteriorly in a blunt point in the middle, leaving considerably more than half the surface shining; fourth segment with yellow pollen except an oval median spot above, which covers the apical two-thirds, but does not extend on the sides.

FIGURE 2.—*Zenillia palpalis*, new species. Palpus of female, outer side. (Drawn by C. T. Greene)

First and second abdominal segments each bearing one pair of median marginals; second and third with one pair of smallish discals, which are quite far forward on the yellow pollinose portion; third with a marginal row, the middle pair very large and stout; fourth segment with irregular bristles extending forward nearly to the base, no distinct row on posterior margin. The terminal ventral segment when exposed appears as a cylindrical tubular structure, not very long, bearing at its apex a minute, shining black prolongation, grooved above, bearing microscopic hairs. Legs black, middle tibia with one bristle on the outer front side and one flexor; hind tibia with an inconspicuous row of small bristles and two larger ones rather far apart almost dividing the length into thirds. Wings a little brownish; third vein with two to four bristles at base; fourth vein with a round oblique curve, the apical cross vein more slender, straight for two-thirds of its length and almost parallel with the margin, then gradually curved toward the tip, joining the costa quite close to the tip a little distance from the third; hind cross vein suberect, joining fourth at two-thirds of the distance from the small cross vein to the bend. Hind calypter light brownish with pale margin; the front one white and subtransparent.

Length, 8–9 mm.

Male.—Front at level of anterior ocellus 0.27 of head width; no orbitals, third antennal joint a little broader than in female, of the same length; palpi distinctly flattened and a little widened at tip, but lacking the pore which is so striking in the female; eyes with same pilosity as in female. Genitalia small, black, the inner forceps straight, slender and close together, the outer slender and almost as long; penis black, slender, with a delicate white flap on front at tip. Claws and pulvilli moderately long.

Paratypes.—Female, U.S.N.M. No. 43691.

Remarks.—Described from five females and one male, reared at Wanaina, Northwest District, British Guiana, March, 1931, by J. G. Myers, from *Castnia licoides* Boisduval. The specimens were received from the Imperial Institute of Entomology, to which the type female, allotype male, and two paratype females are returned.

The peculiar depression, or perhaps a sensory pit, in the palpus does not occur in any other tachinid known to me. It occurs only in the female. The species is distinguished by rather stout bristles throughout. I have compared the type series carefully with *Zenillia libatrix* Panzer (det. Bezzi) and find it agrees well except in having a single bristle on the anteroventral side of the middle tibia. No fine hairlike bristles extending up facial ridges, and in the visible structures at the tip of the abdomen in the female; in *libatrix* the terminal organs are concealed in our specimens by closure of the fourth abdominal segment in a longitudinal slit.

TROPHOPS, new genus

Somewhat allied to *Pexomyia* (*rubrifrons* Perris, the genotype), but differing in having the vibrissae distinctly above oral margin, no costal spine nor infrasquamal setules.

Hypopleural bristles and postscutellum present; eyes and arista bare; palpi and proboscis of ordinary form; parafrontals and parafacials broad, especially the latter, which are bare and about half as wide as clypeal depression; facial ridges bare, low, vibrissae far apart and much above the epistoma, only a little below the lowest curve of the eye; cheeks broad and bulging, almost half the eye height. Third antennal joint nearly three times the second, rather slender and tapering, not quite reaching vibrissae. Length of head at antennae slightly greater than at vibrissae; frontal profile a little greater than facial; clypeus flat, moderately broad.

Scutellum with three lateral pairs of bristles, the apical pair almost equally large, decussate or not, depressed. No discal abdominal bristles on second and third segments.

First vein bare, third with one or two bristles at base, fourth with bend slightly rounded, thence a little concave, ending distinctly, yet not very far before apex of wing. Hind cross vein concave and a little oblique, joining fourth vein at three-fifths of the distance from anterior cross vein to bend.

Genotype.—*Trophops clauseni*, new species.

TROPHOPS CLAUSENI, new species

Black with yellowish pollen on head and thorax. Abdomen shining black with broad bands of gray pollen on the second, third, and fourth segments.

Male.—Front 0.31 of the head width. Head with somewhat silvery pollen except on front and upper orbits where it is distinctly yellow. Frontal stripe wider than one parafacial. Verticals one pair; ocellars of normal size and proclinate; two upper orbitals reclinate, strong, the others rather weak, the lowest at middle of second antennal joint. Antennae black, tip of second joint and basal third of third joint reddish; third joint decidedly slender and tapering, a little more than twice the second, not reaching to vibrissae. Cheek covered with fine dark hair. Palpi brown. Thorax with a pair of very slender stripes outside the acrostichals, much enlarged behind the suture; an outer stripe is broadly divided into two spots, the hindmost elongated. Pleurae black with thin gray pollen. Chaetotaxy: Acrostichal, 3, 3; dorsocentral, 3, 4; humeral, 2; posthumeral, 2; notopleural, 2; presutural, 2 (the inner rather large); supraalar, 3; intraalar, 3; postalar, 2; sternopleural, 2, 1; pteropleural small. No

infrasquamal setules. Propleura and prosternum bare. Abdomen mostly shining black, basal two-thirds of second segment, one-half of third segment, and two-thirds of fourth segment with gray pollen. A delicate median black line on these segments. No marginals on first segment, those of second depressed and inconspicuous, third with a median pair and two lateral, fourth with a marginal row and a single subdiscal pair far back. Genitalia black. Legs black (only hind ones present); hind tibiae with rather dense fringe of uniform bristles on anterodorsal side. Hind pulvilli and claws elongated. Wing considerably brownish except along the veins. Costal segment beyond the first vein only slightly longer than the one before it. Calypters white; margin narrow, brownish yellow.

Length, 7.4 mm.

Female.—Front 0.37 of head width (the same in two); usual two pairs of orbital bristles, below the lowest frontals a distinct pollinose dark band extends from the eye to the suture (faintly indicated in male). Hindmost sclerite of venter broadly rounded. Middle tibia with two bristles on anterodorsal side. Claws and pulvilli small.

Length, 5.7–7.7 mm.

Type.—Male, U. S. N. M. No. 43695.

Remarks.—Described from one male and three females (one of the latter considerably broken), reared from *Popillia japonica* Newman; male and two females at Toyona, Japan, July 9, 1930, by T. R. Gardner; the other female, which is broken, at Takarozawa, Japan, by C. P. Clausen, July, 1928. The species is named in honor of C. P. Clausen, who has made an extensive study of the Japanese beetle parasites in Japan and adjacent regions.

Genus EXORISTOIDES Coquillett

Exoristoides Coquillett, Revision of the Tachinidae of America north of Mexico, p. 90, 1897.—Walton, Proc. Ent. Soc. Washington, vol. 17, p. 96, 1915.—Aldrich and Webber, Proc. U. S. Nat. Mus., vol. 63, art. 17, p. 10, 1924.—Curran, Can. Ent., vol. 58, p. 85, 1926.

Exoristopsis Townsend, Proc. U. S. Nat. Mus., vol. 49, p. 426, 1915.

The genotype of *Exoristoides*, designated by Coquillett in 1897, is *johnsoni* Coquillett; that of *Exoristopsis*, designated by Townsend in 1915, is *setifera* Townsend.

The genus has the general characters of *Exorista* of authors (*Zenillia* sens. lat. of Aldrich and Webber, 1924), with the addition of a large pteropleural bristle and almost invariably some setules on the first vein. Curran suggests that *Lypha* is a near relative, which is true. Townsend placed one of our species (*slossonae*) in *Lydina* (*Polidea* of authors), in the National Museum collection some years ago, and this also expressed a true relation. *Lypha* may be distin-

guished by the frontal bristles, which extend remarkably far down on the parafacials; and both genera differ from *Exoristoides* in having the eyes smaller and cheek wider, as well as in lacking any hairs on the first vein. In the single known specimen of *Exoristopsis* both pteropleurals are broken off, but the large scars are present.

Three species were originally included, *johnsoni*, *slossonae*, and *harringtoni*, of which the last has been removed as type species of the genus *Homalactia* Townsend.

KEY TO SPECIES OF EXORISTOIDES

MALES

1. Third antennal joint very wide, two-thirds as wide as long, with obliquely truncate apex (North Carolina to Louisiana and California) ---------- johnsoni Coquillett
   Third antennal joint less than half as wide as long ---------- 2
2. First vein with few setules, rarely none; fourth abdominal segment wholly black (New Hampshire to Alabama) ---------- slossonae Coquillett
   First vein with complete series of setules from near humeral cross vein (Trinidad, West Indies) ---------- urichi, new species

FEMALES

1. First vein setulose from near humeral cross vein to tip ---------- 2
   First vein with only a few setules, at most on basal half ---------- 3
2. Third antennal joint concave on front edge, widened at tip. urichi, new species
   Third antennal joint straight, not widened apically (Peru). setifera Townsend
3. Sternopleurals two; fourth abdominal segment red ---------- johnsoni Coquillett
   Sternopleurals three; fourth abdominal segment wholly black. slossonae Coquillett

EXORISTOIDES JOHNSONI Coquillett

Exoristoides johnsoni COQUILLETT, Revision of the Tachinidae of America north of Mexico, p. 91, 1897.—WALTON, Proc. Ent. Soc. Washington, vol. 17, p. 97, 1915.—BRIMLEY, Ent. News, vol. 33, p. 22, 1922.

The material in the National Museum at present referred to this species is the following: Holotype, female, Hertford County, N. C. (collection Coquillett); one female, Raleigh, N. C. (Brimley); one female, Palo Alto, Calif. (W. F. Derby coll., through the Aldrich collection); one female, Opelousas, La. (Pilate); one female, Lindsey, Calif. (McGregor); one dwarf male, reared at Capa, S. Dak., from *Gryllus abbreviatus* Serville, by Prof. H. C. Severin, emerged September 12, 1919; two males and one female, reared at Sacramento, Calif., from *Gryllus assimilis* Fabricius, by C. C. Wilson, emerged March 27, 1930; and one female, reared at Winters, Calif., by the same entomologist from the same host, emerged April 10, 1931. Thus there are three different rearing records from *Gryllus*, and these are the only ones yet known.

EXORISTOIDES SLOSSONAE Coquillett

Exoristoides slossonae COQUILLETT, Revision of the Tachinidae of America north of Mexico, p. 91, 1897.—JOHNSON, Catalogue of the insects of New Jersey, p. 671, 1899, and p. 779, 1910.—Banks, Ent. News, vol. 23, p. 110, 1912.—WALTON, Proc. Ent. Soc. Washington, vol. 17, p. 97, 1915.—BRITTON, Check-list of the insects of Connecticut, p. 192, 1920.—BRIMLEY, Ent. News, vol. 33, p. 22, 1922.—JOHNSON, List of the Diptera of New England, p. 199, 1925.—WEST, A list of the insects of New York (Cornell Univ. Agr. Exp. Sta. Mem. 101), p. 815, 1928.—ALLEN, Ann. Ent. Soc. America, vol. 22, p. 687, 1929.—CURRAN, Bull. Amer. Mus. Nat. Hist., vol. 61, p. 106, 1930.

Exorista spinipennis COQUILLETT, Revision of the Tachinidae of America north of Mexico, p. 95, 1897.—JOHNSON, Ent. News, vol. 15, p. 157, 1904; Catalogue of insects of New Jersey, p. 780, 1910.—SMITH, Psyche, vol. 24, p. 58, 1917 (syn.).—GIBSON, Ann. Rep. Ent. Soc. Ontario, p. 119, 1918.—ALDRICH and WEBBER, Proc. U. S. Nat. Mus. vol. 63, art. 17, p. 10, 1924.

The material in the National Museum referred to *slossonae* is as follows: Four types of *slossonae*, both sexes, from Franconia, N. H. (Mrs. Slosson), Eastport, Me. (coll. C. V. Riley), and Westville, N. J. (Johnson); the female type of *spinipennis* Coquillett, from Tifton, Ga. (Pilate); a female from Franconia, N. H. (Townsend); a male from Chevy Chase Lake, Md. (Townsend); a female from Potomac Run, Va. (McAtee); two males from College Park, Md. (Walton); a male from La Fayette, Ind. (Aldrich); and a male from Birmingham, Ala., reared by H. L. Weatherbee from *Epilachna corrupta* Mulsant, the Mexican bean beetle. The last emerged on August 3, 1922, and this is the only rearing record.

EXORISTOIDES SETIFERA Townsend

Exoristopsis setifera TOWNSEND, Proc. U. S. Nat. Mus., vol. 49, p. 426, 1915.

The only specimen in the National Museum is the type, a female from Peru.

The characters given for the genus *Exoristopsis* by Townsend seem mostly specific, especially when considered in relation to the other species than *johnsoni*, which I here include. Perhaps the most important is the small size of the ocellars, which is shared by *urichi*, new species. No mention is made of the pteropleurals, which are broken off, but the scars are distinct.

EXORISTOIDES URICHI, new species

Black with silvery-gray pollen. Fourth abdominal segment red or reddish in ground color with yellow pollen.

Male.—Front 0.27 of head width, pollen of the head silvery gray, the posterior orbit and upper part of front slightly yellow. Ocellars hairlike, proclinate, two upper frontals reclinate, six others, the lowest at the level of the base of third antennal joint. Antennae

mostly black; tip of second and base of third antennal joints reddish, this color extending to the middle of the third on inner side; third antennal joint three times the second, rather wide, at its middle almost twice as wide as the parafacial, somewhat prominent at base and tip on the front side, leaving a distinct concavity between, the apex truncate, reaching nearly to vibrissae. Arista with penultimate joint a little elongate, barely twice as long as thick, the apical joint rather short, thickened nearly to the middle. Eyes with long pile. Cheek a little more than one-fourth the eye height. Palpi slender, yellow apically, dark brown on basal half; outer verticals distinct, three-fourths as long as the inner. Mesonotum with rather thin silvery-gray pollen, leaving four longitudinal shining black stripes, the inner narrow and reaching halfway from the suture to the scutellum; an elongate median spot before the scutellum. Acrostichal 3, 3; dorsocentral, 3, 3; sternopleural, 2, 1. Scutellum, with 3 lateral bristles, a small erect nondecussate hairlike apical pair. Propleura and prosternum bare. Second and third segments of abdomen of same color as thorax, in some lights showing pollen to the apices of the segments; fourth segment with more yellowish pollen, the ground color rather dark red; first segment with no median marginals, second with one pair, third with a median pair and two or three at the margin; second and third segments with a single pair of discals much smaller than marginals; fourth segment with a median row of six large bristles and a marginal row of the same number considerably smaller. Genitalia red, small, very similar to those of the other species; the inner forceps blackish, being united into a beaklike process curved upward and acute at tip; outer forceps slender, curved like the inner with a minute tooth at apex. Legs black, all the tarsi rather short and decreasing in width. All the claws and pulvilli very small. Front tibiae with two bristles near middle on posteroventral side; middle tibiae with four bristles on anterodorsal side, the two middle ones quite long, and with one ventral; hind tibiae with an uneven sparse row on anterodorsal side. Wings hyaline, the first vein hairy to tip from humeral cross vein; third vein with coarse hairs nearly to cross vein; fourth vein with rounded almost rectangular bend, then concave, reaching costa only a little before apex. The first posterior cell open. Hind cross vein straight, somewhat oblique, joining fourth vein considerably beyond middle of the distance between anterior cross vein and bend. Calypters white, the hind ones subtransparent; infrasquamal setules present but delicate.

Length, 6. 5 mm.

Female.—Front at vertex 0.27 of the head width. The pollen on upper two-thirds much more distinctly yellow than in the male. Third antennal joint more than twice the second, distinctly wider

than the parafacial, its tip widened about as in the male but the basal part not protruding noticeably in the vicinity of the arista. Palpi as in the male. Fourth abdominal segment distinctly red in ground color, shining in some lights over most of its surface. Genitalia simple. Front tarsi a little widened from the second joint, the claws and pulvilli very small.

Length, 6.2 mm.

Type.—In the British Museum of Natural History.

Remarks.—Described from one male and one female, reared in Trinidad, West Indies, by F. W. Urich, from pupae of *Calpodes ethlius* Cramer. The specimens were received from Sir Guy A. K. Marshall, director of the Imperial Institute of Entomology, in London, to whom they are returned for ultimate deposit in the British Museum.

Genus ACHAETONEURA Brauer and Bergenstamm

Achaetoneura BRAUER and BERGENSTAMM, Zweiflügler des kaiserl. Museums zu Wien, pt. 5, p. 334, 1891 (Denkschr. kaiserl. Akad. Wiss., vol. 58).—WEBBER, Proc. U. S. Nat. Mus., vol. 78, art. 10, p. 1, 1930.

ACHAETONEURA NIGRIPALPIS, new species

Entirely black, including antennae, palpi, and scutellum.

Female.—Front at vertex 0.3, 0.31 (in the two specimens) of the head height. Head with silvery pollen tinged with light yellow on the front; third antennal joint two and one-half times the second. Arista slender, bare, third joint very slightly thickened basally. Parafacial a little wider than third antennal joint. Facial ridges with rather small bristles extending to middle of third antennal joint. Cheek one-fourth eye height. Thorax gray pollinose with four black stripes, the inner pair abbreviated behind and the outer interrupted at suture. Scutellum subshining black at base. Acrostichal, 3, 3; dorsocentral, 3, 4; scutellum, with 3 lateral pairs of bristles, the apicals rather strong, decussate, depressed; sternopleural, 2, 2, the anterior of the hindmost somewhat hairlike; propleura bare. First abdominal segment black, the second and third black on apical two-fifths, their bases with smooth gray pollen which is sharply defined behind; fourth segment wholly pollinose with a slight yellow tinge. No discals on second and third segments, a pair of marginals on first and second, marginal row of six on the third; fourth with a row of bristles in the middle, the marginals small and inconspicuous. Venter with a somewhat reddish tinge. Legs black; anterior tibiae with two posteroventral bristles; middle tibiae with two large anterodorsal, two small posterodorsal and one ventral; hind tibiae with a complete row of small bristles on posterodorsal side, one in middle slightly larger. Anterior tarsi with third and

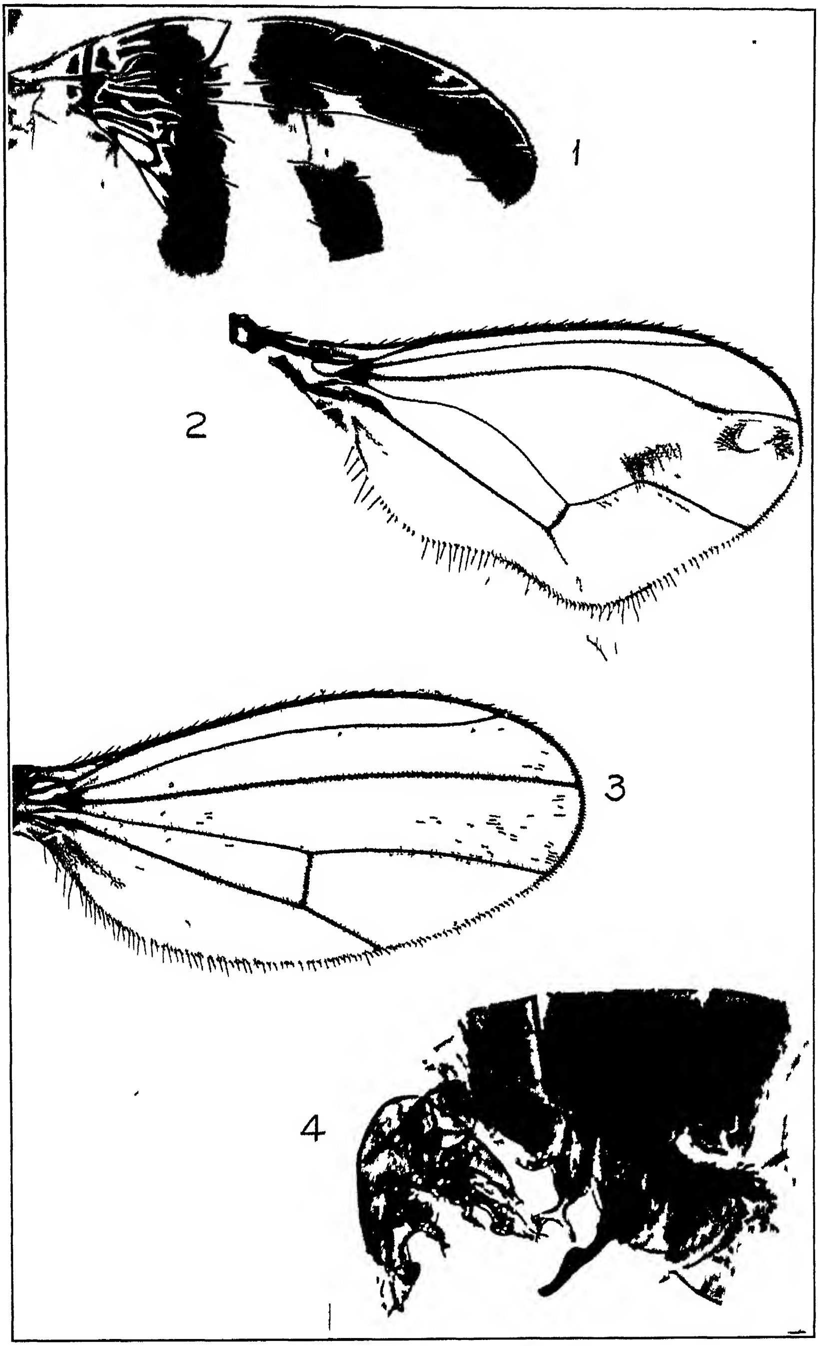
fourth joints slightly flattened; claws and pulvilli small. Wings subhyaline with the usual venation for the genus; third vein with three setules at base. Calypters white.

Length, 7.6–8.5 mm.

Paratype.—Female, U. S. N. M. No. 43694.

Remarks.—Described from two females reared by F. W. Urich, in Trinidad, from pupae of *Calpodes ethlius* Cramer. The specimens were received from Sir Guy A. K. Marshall, of the Imperial Institute of Entomology, and the type is returned to him for ultimate deposit in the British Museum.

Compared with the females of the genotype *A. frenchii* Williston, the head appears a little rounder, the eye longer vertically, the third antennal joint shorter and the bristles of the facial ridges do not extend so high. In chaetotaxy and other generic characters it agrees very well.



DYSCRASIS AND COLLINELLULA NEW GENERA

1, *Dyscrasis hendeli*, new species Wing (Enlarged 16 diameters) 2-4, *Collinellula magistri*, new species 2, Wing of male 3 wing of female, 4, abdomen of male, side view, flattened, with genitalia twisted to show dorsal view (Enlarged 60 diameters) All photographed from microscopic slides

A CACHE OF BASKET MAKER BASKETS FROM NEW MEXICO

BY

WALTER HOUGH
Head Curator, Department of Anthropology
United States National Museum

No. 2933.—From the Proceedings of the United States National Museum
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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
WASHINGTON, D. C.
1932

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By Walter Hough

Head Curator, Department of Anthropology, United States National Museum

The joint expedition of the Smithsonian Institution and the Peabody Museum of Yale University worked during 1929 in a cave in Dona Ana County, N. Mex., which was thought to contain the remains of a sloth. A specimen of this animal was taken from an adjoining cave by a previous expedition of the Peabody Museum in 1928, and this has been described by Dr. R. S. Lull.[1] In neither of these caves were observed artifacts or other remains of man, but in a crevice adjoining, though not connecting with, the second cave, Norman Boss, of the United States National Museum, discovered a cache of baskets of particular interest. These are described below.

With the baskets were found a slender rod of dressed wood truncated at the ends, a fragment of gourd, and a lenticular mass of whitish clay with numerous finger impressions. Evidently the soft clay had been pressed into a vessel with concave surface, probably to stop a crack (pl. 1, fig. 1). With the baskets was a very little débris, consisting of dust containing skulls of mice and fruits and thorns of desert plants.

OVAL BOWL

The sides of this specimen have been eroded away, and at present the basket is an oval tray with upcurved ends. The construction of a basket of this shape undoubtedly presented unusual difficulties to the weaver. The oval section of 14 coils proceeded regularly, comprising the bottom field of the basket. The formation of the sides of an oval basket necessitated the insertion of numerous rods. These splicings or injunctions appear on the inner axis of the oval. The fifteenth coil is inserted about an inch to the right of the minor axis; the sixteenth an inch to the right; the seventeenth the same distance to the right; and the eighteenth the same distance to the right of the last. These four coils run around to the left and terminate in a similar way oppositely at the foot of the basket wall on the margin

[1] Lull, Richard Swann, A remarkable ground sloth. Mem Peabody Mus, Yale Univ., vol. 3 pt. 2, 1929.

of the fourteenth coil. When these insertions were put in, the coil could run twice continuously around, when new insertions were necessary. A cross section shows 23 coils, but this appears not to be the whole number. The insertions were 12 in number, all lying in the minor axis, or to the right. The end sections of the basket required no insertions, the wall being built as if it were the process of the customary round basket.

The pattern consists of pairs of zigzags worked in black, probably devils-claw arranged axially, except the upper zigzag, which has three arms (see pl. 2, fig. 2). This pattern would be called a lightning design of the four points of the compass. The lightning elements broaden toward the rim. Diameter, 17¾ inches by 16¼ inches; height, 5¾ inches (U.S.N.M. No. 245916). This basket is an example of the devices used to work out eccentric shapes as in the Klikitat and some northern baskets described by Boas and others.[2] It is apparently the earliest specimen showing this technique.

LARGE BASKET BOWL

Regularly sewed, over a rather large coil. The rim coil shows at only one place, five coils having been worn away. From the caked débris on parts of the basket it is inferred that it was used for mortuary purposes. From the tenth coil arise stepped figures in black extending over 16 coils and rising three steps. On the walls of the basket are at wide intervals small sections vertical and horizontal in black, the vertical extending down from the rim. The figures are obscured by fading and can be traced only on the bottom of the basket. There are 50 coils in the basket. The material is willow, the method two rod and splint. The design appears to be in *Martynia* (devils-claw, or unicorn plant). Diameter, distorted, 19½ inches by 16 inches; height, approximately 6½ inches. (Pl. 3, fig. 2.)

CARRYING BASKET

Widely flaring, ovate basket in fragmentary condition. Much of the stitching has been worn away, especially where the basket came in contact with the body. Repairs of extremely crude stitching with yucca have been made, and several sections of coil have broken away on one side. The bottom of this basket is flat. The foundation coils are long-oval, and the oval shape is built up the walls to the top, giving a basket of long-ovate outline suitable for carrying a load adjusted to the back. There are no traces of design. The rods

[2] Haeberlin, H K, Teit, James A, and Roberts, Helen H under the direction of Franz Boas, Coiled basketry in British Columbia and surrounding region 41st Ann Rep. Bur. Amer. Ethnol, for 1919–1924, pp 119–626, 1928

and sewing are willow, and the splint is of yucca. No remains of the attachment of the carrying straps are to be seen on this basket. This specimen is to be compared with carrying baskets of similar shape discovered by Guernsey in Basket Maker sites in northeastern Arizona and described as Pueblo I.[3] Diameter of bottom, 8 inches by 6 inches; height, 13½ inches. (Pl. 3, fig. 1.)

BOWL

Shallow with flat bottom and rather steep sides. Sewing of narrow willow splints not closely applied, leaving interspaces on the rods. Willow, two-rod foundation, and splint after the earliest coil and sewing method. Twenty-seven coils compose the basket, and the edges are finished off by sewing in the splints. The specimen is distorted by pressure, which gives additional flatness to the bottom. Some mending shows on the bottom coils. The specimen has been taken from cave débris, some of which still adheres. Diameter, 9½ inches; height, 3½ inches. (Pl. 1, fig. 2.)

The baskets are in rather good condition of preservation, showing previous wear and repair, and but little affected by their long burial. Two of the baskets show repairs, which have been made with strips of yucca crudely sewed in, merely to hold the edges of the breaks together. Many other instances of repair with yucca are seen in Basket Maker specimens found in other localities.

The presence of this cache of baskets in Dona Ana County furnished good data on the diffusion of Basket Maker culture. The cache has not yet been correlated with a site of these Indians in the neighborhood. There is evidence that future work will extend greatly the range of the southern Basket Makers.

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[3] Guernsey, Samuel J., Explorations in northeastern Arizona. Papers Peabody Mus. Amer. Archeol. Harvard Univ., vol. 12, no 1., pl. 13 (p. 95 for description), 1931.

Several baskets of this type have been found in northeastern Arizona, notably by Dr. Byron Cummings.

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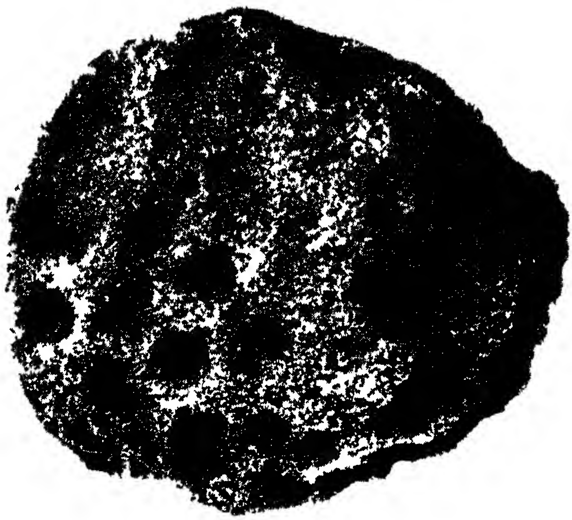

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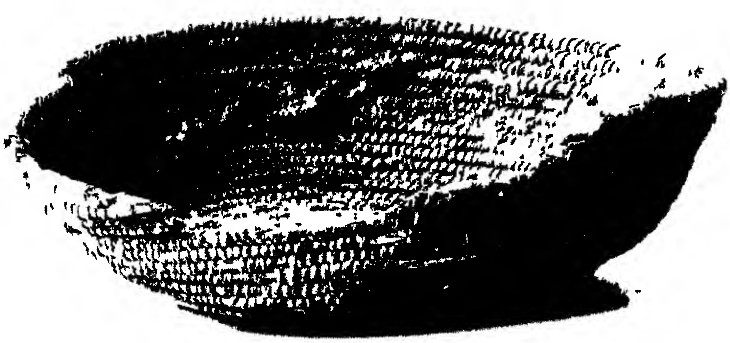

2

1 Clay with Finger Impressions (p 1) 2 Coiled Bowl (p 3)

1

2

1, OVAL BOWL (SIDE VIEW); 2, DECORATIVE DESIGN ON OVAL BOWL (P. 1)

1

2

1, CARRYING BASKET; 2, LARGE COILED BOWL (P. 2)

THE FORMS OF THE COMMON OLD WORLD SWALLOWTAIL BUTTERFLY (PAPILIO MACHAON) IN NORTH AMERICA, WITH DESCRIPTIONS OF TWO NEW SUBSPECIES

BY

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By Austin H. Clark

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The common Old World swallowtail, *Papilio machaon*, is found in North America from western Alaska south of Cape Prince of Wales to Yukon and southward to the extreme northwestern portion of British Columbia, and also from the southeastern extremity of James Bay to the Nelson River on the western shore of Hudson Bay and southward to Lake Superior.

Although it is locally common in many places in both the western and eastern portion of its range, its habitat is so remote and inaccessible that it is a rare insect in collections. Indeed, only seven specimens are known from eastern North America.

In the present paper the status of the American forms of this species is reviewed, and three subspecies are recognized: *Papilio machaon aliaska* Scudder, which is found throughout the western portion of the range; *P. m. hudsonianus*, new subspecies, occurring in the eastern portion of the range; and *P. m. petersii*, new subspecies, from central Alaska, where it occurs with *P. m. aliaska*, of which possibly it is an extreme form.

Papilio machaon was first discovered in North America by Constantin Drexler during an exploration that he made in 1860 in the region of James Bay under the direction of the Smithsonian Institution. Thanks to the facilities afforded him by the Hudson's Bay Co., he was enabled to collect a large quantity of valuable material, which was sent from Moose Factory to London by the company at their expense and later brought to New York free of charge by the Cunard Steamship Co.

At that time the Smithsonian Institution did not maintain a collection of insects, and the four specimens of *Papilio machaon* that he collected were sent to William Henry Edwards. Edwards received from Drexler many other butterflies, among them one of the specimens upon which the description of *Hesperia wyandot* was based, and one of those from which *Pamphila verna* was described, both from Washington, D. C.

From 1865 to 1868 Lieut. William Healy Dall was engaged in work in Alaska under the auspices of the Smithsonian Institution. He made extensive zoological collections, including large numbers of insects. Among the insects were numerous examples of *Papilio machaon*, which on their arrival in Washington were sent to Samuel Hubbard Scudder at Cambridge, Mass.

In 1863, J. William Weidemeyer in listing *Papilio zolicaon* gave as the habitat "Labrador; United States." It is probable that the mention of Labrador was based upon the specimens collected by Drexler and subsequently sent to Edwards, though there is no proof of this. At that time Edwards had not described *oregonia*, and as *zelicaon* Lucas (=*zolicaon* Boisduval) was the only yellow representative of the *Machaon* group known from North America, any yellow form in that group would have been referred to it.

The first definite record of *Papilio machaon* in America was published by Edwards, who wrote in 1868 that some years before he had received several specimens that had been taken by Drexler at Rupert House, Hudson Bay.

Scudder, in 1869, described *Papilio aliaska*, which was based upon 16 specimens collected by Lieutenant Dall, most of them at Nulato (or Nualto), May 20–24, but others on June 5, 6, and 14 at a short distance below the Ramparts (on the Yukon River in central Alaska) and also just above them. Scudder said that Edwards had sent him a specimen from the east coast of Hudson Bay. This was one of the specimens collected by Drexler.

Scudder wrote that his new *Papilio aliaska* was of the same size and facies as *P. zolicaon*. This makes it clear that his description was based upon one or all of the specimens collected by Lieutenant Dall, as the Alaskan form of *P. machaon* is very dark and is in general much like *P. zelicaon*.

In 1882, Edwards said that the specimens from Rupert House had been collected in 1860 by C. Drexler when traveling under the auspices of the Smithsonian Institution. They were picked off the gooseberry bushes early in the morning while stiffened with cold. The species was abundant there. He noted that Lieutenant Dall took his examples at Nulato, and that Lucien M. Turner and E. W. Nelson had found the species common at St. Michael. He remarked that there was great uniformity between all the American specimens he had—four from Hudson Bay and eight from Alaska.

Having assembled a series of the various forms of *Papilio machaon*, he had found that the American form is more melanic than the Old World forms with the exception of that from the Himalayas, and he said that if Ménétriés had not limited his *asiaticus* to the examples that have a straight edge to the inner side of the marginal border of the hind wings his name probably should cover the Ameri-

can form. The American examples, he said, come nearest—and indeed are very near—to the variety from the Himalayas.

In 1883, Edwards said that the Himalayan and the American forms should be united under one name, unless, when more is known of the latter, greater differences appear than we now discover.

In "The Butterfly Book," published in 1898, Dr. W. J. Holland, under *Papilio aliaska*, wrote that "thus far this insect has been received only from Alaska." Under the name of *Papilio machaon* var. *aliaska* he figured, without comment, a specimen that did not come from Alaska at all, but was the one collected by Drexler at Rupert House that Scudder in 1869 said had been sent him by Edwards. He later returned it to Edwards, and it came into the possession of Doctor Holland through his acquisition of the Edwards collection.

In 1905, M. Roger Verity placed *P. m. kamtschadalus* Alphéraky in the synonymy of *P. aliaska* Scudder, and said that *aliaska* is found in the peninsula of Kamchatka and in Alaska. He gave a colored figure of a specimen from Kamchatka identified as *aliaska*, which, except for the narrower black border of the hind wings, very closely resembles Holland's figure of *Papilio machaon* var. *aliaska*. Verity cited Holland's figure, which he evidently considered as representing true *aliaska* Scudder.

In 1906, Wright, in his "Butterflies of the West Coast," recorded *Papilio zolicaon* from Port Wrangel, Alaska, on the southern side of the base of the Alaska peninsula. This is far beyond the range of that species, and the record must have been based upon a specimen of *P. m. aliaska.*

In their revision of the American swallowtails published in 1906, Lord Rothschild and Dr. Karl Jordan gave a synonymy of *Papilio machaon aliaska*, which included notices of individuals from the Hudson Bay region as well as from Alaska and Yukon. The range of the subspecies as given by them—Alaska; Oregon; Hudson Bay—in the west broadly overlaps the ranges of *P. zelicaon* and of the yellow form (*oregonia*) of *P. bairdi*. The inclusion of Oregon was based upon the mention by W. H. Edwards in 1882 of a specimen of *aliaska* from The Dalles on the Columbia River in Wasco County, Oreg., which was probably in reality *zelicaon*, though possibly *P. bairdi* form *oregonia*. Whatever it was it was certainly not *aliaska*. In their synonymy they designated as false the statement made by Edwards that *Papilio machaon aliaska* is the Himalayan form of the species, and they do not question the correctness of the identification of the figure published by Doctor Holland. In the key to the American species of the *Machaon* group, *aliaska* was paired with *Papilio bairdi* form *oregonia*, from which it was differentiated by the absence of a black pupil from the anal ocellus. In the text it was compared only with the very different *P. m. kamtschadalus*, evidently on

the basis of Holland's figure, as is shown by the mention of a black admarginal spot at the distal side of the anal ocellus. Such a spot is conspicuous in specimens from the Hudson Bay region (pl. 3, figs. 1, 2), but there is very seldom any trace of such a spot in Alaskan examples (pl. 2, figs. 1, 2). They listed one bad male in the Tring Museum, but did not give any locality for it.

They gave the range of *Papilio zelicaon* as extending from Alaska, British Columbia, and Alberta southward to Arizona and Colorado. Alaska was included on the strength of Wright's record, which was undoubtedly based upon a specimen of *aliaska.*

In 1907, Verity under the name of *joannisi* described an arctic form of *P. machaon* from Alaska, which is the true *aliaska* of Scudder, as is clearly shown by his photograph. Although Verity made the error of assuming that Holland's figure represents Scudder's *aliaska* and was thereby led to rename the true *aliaska,* he deserves the credit for being the first to point out the fact that *Papilio machaon* occurs in North America in two distinct forms.

In his account of swallowtails of the *Machaon* group occurring in America, published toward the end of 1907 in Seitz's "Macrolepidoptera of the World," Dr. Karl Jordan said that *Papilio machaon* is represented in America by the subspecies *aliaska* Scudder (=*joannisi* Verity) in which the black band on the hind wing is broader than it is in the geographically nearest subspecies *kamtschadalus.* He said that *aliaska* is rather common in July and August at the mouth of the Yukon and other rivers, as well as in the neighborhood of lakes—probably everywhere in the lowlands where Umbelliferae grow. He added that eastward *aliasku* occurs as far as Hudson Bay. The figure he gave represents a typical example of the Hudson Bay form and appears to have been taken from Holland. Doctor Jordan said that *kamtschadalus* Alphéraky is not identical with *aliaska* Scudder.

In 1910, Verity described and figured a new form, which he called *orientis,* from the eastern part of southern Siberia.

In 1916, Francis Kermode recorded *Papilio machaon* var. *aliaska* from Atlin, in the extreme northwest of the Province of British Columbia, northeast of Skagway, Alaska, and just south of the Yukon border, where it had been collected by E. M. Anderson, and figured a typical specimen from that locality.

In 1916, William Barnes and J. McDunnough published a photograph of a male specimen of *Papilio aliaska* from Rampart House, Alaska, resembling the specimen shown on Plate 2, and said that there is no doubt that the form to which Scudder applied the name *aliaska* is the form that Verity redescribed under the name of *joannisi.* They added that the few specimens from Alaska that they personally had seen had all been of the form *aliaska.* They said further

that whether the specimen figured by Holland really came from Alaska or not is an interesting point for collectors to clear up; if it be correct, then there would be two distinct forms of *machaon* in our northern fauna differing in the relative width of the black submarginal band on the secondaries.

In the second edition of "The Butterfly Book," published in 1931, Doctor Holland republished the figure given in 1898, designating it as "type" of *Papilio aliaska.* In the text he said that it is one of the "types" determined by Scudder, and that it was taken at Rupert House on Hudson Bay. It is, therefore, the specimen that Scudder said had been sent him by Edwards. It can not be regarded as the type specimen of *aliaska*, since in the first place the original description fits only the specimens from Nulato and the Ramparts, and in the second place it was only incidentally mentioned by Scudder.

Doctor Holland said that he has another "type" from Scudder's original material labeled as from "Alaska," which exactly agrees with Verity's figure of his *joannisi.* He remarked that the Carnegie Museum has a specimen taken on the peninsula of Labrador, on the eastern shore of Hudson Bay, which is the same. He added that the Carnegie Museum has a long series of specimens from "all parts of Alaska," which are "unmistakably the same thing." These specimens, he said, had been carefully compared with specimens from northeastern Siberia labeled *orientis* by Verity, and they were indistinguishable from the latter. He remarked that in the long suite of specimens that he had critically examined the only difference is an almost inappreciable variation in the width of the black outer margin of the fore wings, which is only individual, and reveals itself both in American and in Asiatic specimens. He said that the insect, as the figure shows, resembles *P. m. machaon* of Europe, but the yellow areas of the wings are not so wide as in the latter.

For some time Foster H. Benjamin had been aware of the very considerable differences between Alaskan and Hudsonian specimens of *Papilio machaon*, and he recently was so kind as to suggest that I look into the matter on the basis of the material in the National Museum, including the Barnes collection.

From the available material *Papilio machaon* appears to be represented in North America by three different forms: One in the region between southwestern Hudson and James Bays and Lake Superior; a second—Scudder's *aliaska*—in Alaska and the adjacent portions of Yukon and Mackenzie; and a third, closely resembling the first, also occurring in Alaska.

The eastern form and the very similar form from Alaska are described below.

PAPILIO MACHAON HUDSONIANUS, new subspecies

PLATE 3, FIGURES 1, 2

Papilio zolicaon WEIDEMEYER, Proc Ent. Soc. Philadelphia, vol. 2, p. 148, 1863 (in part; Labrador).

Papilio machaon W. H. EDWARDS, Can Ent., vol. 1, p. 22, 1868 (Rupert House).

Papilio aliaska (in part) SCUDDER, Proc. Boston Soc. Nat. Hist., vol. 12, p. 407, 1869 (east coast of Hudson Bay [refers to Rupert House]; the specimens from Nulato and the Ramparts, on which the description is based, represent *P. m. aliaska*).—HOLLAND, Butterfly book, 2d ed., p. 314, 1931 ("type" from Rupert House and specimen from Labrador).

Papilio machaon var. *aliaska* W. H. EDWARDS, Papilio, vol. 2, no. 5, pp. 74–75, May, 1882 (Rupert House; particulars of capture; 8 Alaskan specimens are *P. m. aliaska*; comparison with Asiatic forms); vol. 3, no. 3, p 60, Mar., 1883 (= Himalayan form).—HOLLAND, Butterfly book, pl. 41, fig. 1, 1898 (but not *Papilio aliaska*, p. 312, no. 9 = *P. m. aliaska*).—HOLLAND, Butterfly book, 2d ed., pl. 41, fig. 1, 1931.

Papilio machaon a. *aliaska* WILSON, 34th Ann. Rep. Ent. Soc. Ontario, 1903, p. 90, 1904 (Hudson Bay slope; Forget Portage, Nagagami River, 63 miles northward of Montizambert Station, Canadian Pacific Railway, and 22 miles north of height of land, measured along the canoe routes, lat. 49° 12′ 47″ N.).

Papilio machaon aliaska VERITY, Rhopalocera Palaearctica, p. 15, 1905 (includes *P. m. kamtschadalus*; found in Alaska and Kamchatka; his idea of the subspecies based on Holland's figure).—ROTHSCHILD and JORDAN, Nov. Zool., vol. 13, no. 3, p. 553, no. 65*a*, Aug 30, 1906 (in part; Hudson Bay, but not other localities).—JORDAN, *in* Seitz, Macrolepidoptera of the world, vol. 5, p. 24 (in part; Hudson Bay); pl. 8, line b, *aliaska*, male, 1907 (apparently copied from Holland).

Papilio aliaska BARNES and MCDUNNOUGH, Contributions to the natural history of the Lepidoptera of North America, vol. 3, no. 2, p. 54, Dec. 5, 1916 (questions the identity of Holland's figure)

Description.—Larger than *P. m. aliaska* Scudder (the fore wing 40 mm long), with the outer border of the fore wings slightly, though distinctly, convex instead of straight, and the tails on the hind wings shorter, although the hind wings do not differ in shape.

On the *upper side* the black base of the fore wings is much less heavily speckled with olive scales than is the case in *P. m. aliaska;* the black outer border is more nearly of uniform width, not becoming so much broadened posteriorly; the black band across the middle of the outer half of the cell has converging instead of parallel sides, so that the costal end is much broader than the end lying on the lower border of the cell; the veins are rather less heavily black; and the black spot in the yellow triangle between veins SC_4 and SC_5 is smaller and is completely isolated from the black above and below it.

On the hind wings the inner edge of the dark border is more regularly and strongly curved, so that the end of the cell is distant from the dark border about the width of the cell instead of almost touching it as in the case of *P. m. aliaska;* and the black line on the

lower border of the orange anal spot is thicker, encroaching more on the spot itself.

On the *under side* the submarginal yellow spots of the fore wings are rather small, well rounded, and entirely separated from each other by black veins, the row of spots occupying less than half the width of the black border itself, whereas in *P. m. aliaska* this row of spots is represented by a broad yellow band, quite continuous or with indicated interruptions at the veins, which occupies more than half the width of the black border.

On the hind wings the inner margin of the dark border is more regularly curved, the black lines forming this margin being only slightly discontinuous between veins R_2 and R_3 and R_3 and M_1, whereas in *P. m. aliaska* the black lines in these interspaces are very widely separated from the corresponding lines above; the dark border is less heavily washed with blue and olive scales; the submarginal lunules are smaller; the black border of the orange anal ocellus is very narrow laterally, sometimes even almost completely interrupted, but posteriorly is broadened into a conspicuous black oval spot deeply excavating the posterior portion of the ocellus; and there is no orange scaling between the cell and the dark border between veins R_2 and R_3, and R_3 and M_1, or above the orange anal spot. The black border of the anal ocellus above is narrow, as in *P. m. machaon*, and beneath it is a narrow crescent of blue scales.

The dark markings above are dark brown, not intense black as in *P. m. aliaska*, giving the insect a rather washed-out appearance.

Type specimen.—U.S.N.M. No. 34478, female, from Kettle Rapids, Nelson River, Manitoba, on the Hudson Bay Railway, July 8, 1914 (William Barnes collection).

Other specimens examined.—One female from the type locality, and one male from Hymers, Ontario (on the northwestern shore of Lake Superior southwest of Fort William and near the Minnesota boundary), July 8, 1915 (Barnes collection).

Other records.—Rupert House, on the southeastern shore of James Bay (Edwards, 1868, 1882, 1883; Scudder, 1869; Holland, 1931); Labrador (Weidemeyer, 1863; possibly based on the specimens from Rupert House); peninsula of Labrador, on the eastern shore of Hudson Bay (Holland, 1931; possibly one of the specimens recorded by Edwards from Rupert House); Nagagami River, north of Lake Superior (Wilson, 1904).

Range.—From Kettle Rapids, near Port Nelson, at the mouth of the Nelson River on the western shore of Hudson Bay, to Rupert House at the southeastern extremity of James Bay, and Hymers, Ontario, on the western shore of Lake Superior a few miles north of the Minnesota boundary. This form inhabits low and largely forested country.

Season.—July and August.

Comparisons.—*Papilio machaon hudsonianus* is very closely related to typical *P. m. machaon* of western Europe, from which it differs in the slight, but characteristic, convexity of the outer margin of the fore wings, in the shorter tails, in the generally duller color, in the excavation of the orange anal ocellus by the thickening of its black posterior border, and in the small size and isolation of the black spot on the fore wing in the yellow triangle between veins SC_4 and SC_5.

Among its American relatives it is perhaps most easily confused with *Papilio bairdi* form *oregonia.* But the convexity of the outer border of the fore wings, the short tails, the deeper color, the small size of the black spot connected with the orange anal ocellus, which lies on its lower border instead of being more or less completely within it, the narrower dark border of the hind wings, and the usually greater extent of the broad dark abdominal border of the hind wings serve to distinguish it.

PAPILIO MACHAON PETERSII, new subspecies

PLATE 4; PLATE 5, FIGURE 3; PLATE 6, FIGURE 3

Description.—Closely related to *P. m. hudsonianus*, with the same wing shape and the same short tails, but somewhat smaller (the fore wing 37 mm long) and darker yellow.

On the *upper side* the fore wings have the dark border very slightly narrower, and there are almost no olive scales in the black basal portion.

On the hind wings the orange anal ocellus is circular and is bordered, except for a short sector one end of which adjoins the outer half of the lower end of the dark margin, by a narrow black ring, which is about twice as broad above the ocellus as elsewhere.

On the *under side* the yellow is deeper than in *P. m. hudsonianus*, especially on the hind wings. On the fore wings the submarginal spots are united into a broad band with straight borders crossed by hairlike black veins, and the dark border is narrower than on the upper surface. The yellowish scaling on the black basal portion of the wing is confined to the cell, where it is less extensive than it is in *P. m. hudsonianus.*

On the hind wings the submarginal lunules are larger and the dark border is slightly narrower, the inner ends of the lunules lying about midway between the edge of the wing and the inner edge of the dark border instead of nearer the former as in *P. m. hudsonianus.*

Type specimen.—U.S.N.M. No. 34479, male (pl. 4), from the Koyukuk River, central Alaska (lat. 67°–69° N., long. 151° W.), captured in the summer of 1901 by Capt. W. J. Peters, now of

the Department of Terrestrial Magnetism, Carnegie Institution of Washington.

The preceding information was taken from the label accompanying the specimen. Captain Peters writes me that the collection of insects that included this specimen, and also several examples of *P. m. aliaska*, was made by Tom Hunt, one of his field men, between the middle of June and August 10, 1901, along the western slope of the valley of the Totsenbetna River, and from the headwaters of the Anaktuvuk River down this river to the Arctic Ocean.

Additional specimen.—A male from the Ramparts, on the middle Yukon, taken at an altitude of 1,000 to 3,000 feet in June, 1922, of which Dr. Karl Jordan was so very kind as to send me photographs of both surfaces (pl. 5, fig. 3; pl. 6, fig. 3; see page 13) is very close to the type, which was captured about 75 miles to the north.

The light dusting on the dark base of the fore wings above, and on the dark outer border just within the row of yellow spots, is as heavy as in most specimens of *P. m. aliaska*—heavier than in some. On the hind wings the blue spots on the dark margin between the lunules and the inner border are prominent, though rather small as in the type. On the under side the light scaling on the black band following the submarginal yellow band on the fore wings is well developed, forming a narrow median line, and the light dusting between the submarginal lunules and the inner edge of the dark border on the hind wings is heavy. These features are probably due to the fact that this is a fresh specimen, while the type is rather worn.

The wing shape of this specimen is identical with that of the type, as is shown by superposition of photographs before a strong light. On the upper surface the band across the outer half of the cell of the fore wing is narrower than in the type, and the inner margin of the dark outer border of the hind wing is somewhat more evenly curved. On the under side of the fore wing the band across the middle of the cell and that across the end of the cell are slightly narrower than in the type.

Note.—*Papilio machaon petersii* bears much the same relation to *P. m. hudsonianus* that *Papilio glaucus arcticus* bears to *P. g. glaucus* and *P. marcellus marcellus* bears to *P. m. lecontei*. It appears to be a dwarf form living under rigorous conditions.

The present subspecies differs from *P. machaon hudsonianus* in the direction of *P. m. kamtschadalus*, which is a small deeply colored form with the outer border of the wings convex, short tails, a submarginal band on the under side of the fore wings, and enlarged submarginal lunules on the hind wings. Indeed, both *P. m. petersii* and *P. m. hudsonianus* might be considered, especially on the basis of the wing shape and the color, to be more closely related to *P. m. kamtschadalus* than to any other subspecies of *P. machaon*. Verity

was to a large extent justified in regarding *kamtschadalus* as a synonym of *aliaska*, interpreted on the basis of Doctor Holland's figure. In *P. m. kamtschadalus*, however, the black markings are more restricted than they are in the corresponding American forms, the dark border on the hind wings in particular being very narrow, that portion within the row of submarginal lunules being not so broad as the lunules themselves.

PAPILIO MACHAON ALIASKA Scudder

PLATE 2, FIGURES 1, 2; PLATE 5, FIGURES 1, 2, 4–6; PLATE 6, FIGURES 1, 2, 4–6; PLATES 7, 8

Papilio aliaska SCUDDER, Proc. Boston Soc. Nat. Hist., vol. 12, p. 407, 1869 (description; Alaska, Nulato and a short distance below the Ramparts, and also just above them; specimen from Hudson Bay is *hudsonianus*).—HOLLAND, Butterfly book, p. 312, 1898 (Alaska; not pl. 41, fig. 1, which is *hudsonianus*).—BARNES and MCDUNNOUGH, Contributions to the natural history of the Lepidoptera of North America, vol. 3, no. 2, p. 54, pl. 4, fig. 2, Dec. 5, 1916 (Rampart House; *joannisi* Verity a synonym of *aliaska*).—HOLLAND, Butterfly book, 2d ed., p. 314, 1931 (Alaska; includes *joannisi* Verity; specimens from Rupert House and Labrador are *hudsonianus*).

Papilio machaon var. *aliaska* W. H. EDWARDS, Papilio, vol. 2, no. 5, pp. 74–75, May, 1882 (St. Michael; comparison with Old World forms; specimens from Rupert House are *hudsonianus*); vol. 3, no. 3, p. 60, Mar., 1883 (same as the Himalayan form).—LYMAN, Can. Ent., vol. 32, no. 4, p. 119, Apr., 1900 (Dawson, Yukon).

Papilio machaon a. *aliaska* KEELE, 35th Ann. Rep. Ent. Soc. Ontario, 1904, p. 61, 1905 (quite common along the shores of Mayo Lake and valley of Mayo River, Yukon, during July and August).

Papilio zolicaon WRIGHT, Butterflies of the West Coast, p. 86, 1906 (in part; Port Wrangel, Alaska).

Papilio zelicaon ROTHSCHILD and JORDAN, Nov. Zool., vol. 13, no. 3, p. 550, Aug. 30, 1906 (Alaska; based on Wright's record).

Papilio machaon aliaska ROTHSCHILD and JORDAN, Nov. Zool., vol. 13, no. 3, p. 553, no. 65*a*, Aug. 30, 1906 (synonymy; Alaska, but not Oregon or Hudson Bay).—JORDAN, *in* Seitz, Macrolepidoptera of the world, vol. 5, p. 24, 1907 (Alaska; Hudson Bay refers to *hudsonianus*, which is the form figured; includes *joannisi* Verity).—KERMODE, Rep. Provincial Mus. Nat. Hist. (British Columbia) for the year 1915, p. N 16, pl. 8, fig. 1, 1916 (Atlin, British Columbia).

Papilio machaon joannisi VERITY, Rhopalocera Palaearctica, p. 12, pl. 10, fig. 16, 1907 (Alaska).—JORDAN, *in* Seitz, Macrolepidoptera of the world, vol. 5, p. 24, 1907 (synonym of *aliaska*).—BARNES and MCDUNNOUGH, Contributions to the natural history of the Lepidoptera of North America, vol. 3, no. 2, p. 54, Dec. 5, 1916 (synonym of *aliaska*).—HOLLAND, Butterfly book, 2d ed., p. 314, 1931 (synonym of *aliaska*).

Note on the type specimen.—Prof. Nathan Banks, of Harvard University, has been so kind as to write me that there is in the collection of the Museum of Comparative Zoology at Harvard College a speci-

men bearing the label "*aliaska*, male, type, S. H. S." in Scudder's handwriting. It also carries a museum type label placed with it by Samuel Henshaw.

Professor Banks was good enough to compare this type specimen with prints of the photographs shown as Figure 1 on Plate 2, and Figure 1 on Plate 3. He writes that the type specimen agrees with the specimen shown as Figure 1 on Plate 2 in having the first broad pale band crossing the cell of the primaries with parallel sides and not widened posteriorly, as well as in the other points about which I inquired. On the back of the photograph reproduced as Figure 1 on Plate 2 he wrote "type like this."

The specimen shown on Plate 2 may therefore be regarded as typical of *P. m. aliaska.*

Specimens examined.—Seventeen, with the following data: Nushagak, Alaska (eastern end of Bristol Bay, at the base of the Alaska Peninsula), July 5, 1881; St. Michael, Alaska (on the southern shore of Norton Sound); Big Hurrah Creek, 40 miles northeast of Nome, on the northern shore of Norton Sound; Rampart (on the Yukon in central Alaska), June 22; Koyukuk River, central Alaska (lat. 67°–69° N., long. 151° W.), summer of 1901, Capt. W. J. Peters; Alaska, vicinity of the Porcupine River on the Alaska-Yukon boundary (lat. 67° 25′ and 66° 31′ N., long. 141° W.), June 12, 1912; Yukon, Canada, July 18, 1916; Nahanni Mountains, Mackenzie, at an altitude of 2,500 feet, July 16, 1903.

In addition to these specimens I have been able, thanks to the generosity of Dr. Karl Jordan, to study most excellent full-size photographs of both surfaces of 12 specimens from the Ramparts on the middle Yukon taken at an altitude of 1,000 to 3,000 feet in June, 1922, which are in the collection of the Zoological Museum at Tring, Hertfordshire, England (pls. 5–8).

Range.—From Bristol Bay (Nushagak River) north to Cape Prince of Wales (Big Hurrah Creek) and eastward, extending north of the Arctic Circle on the Koyukuk River in central Alaska and on the Canadian border, as far as Mayo Lake, Yukon, the Nahanni Mountains, Mackenzie, on the Yukon-Mackenzie boundary just north of British Columbia (lat. 60° 48′ N., long. 122° 40′ W.), at an altitude of 2,500 feet, and Atlin, in the extreme northwest of British Columbia. This form inhabits mountainous or rugged country, where it is found near woods or patches of trees or in sparsely wooded areas.

Season.—From the third week in May to August; most of the records are in June and early July.

Variation.—*Papilio machaon aliaska* is a very variable form, at least in certain localities. Although the specimens figured by Verity,

Barnes and McDunnough, and Kermode are strikingly similar and most of those that I have seen resemble them closely, the series from the Koyukuk River and those in Lord Rothschild's collection from the Ramparts about 75 miles to the southward (pls. 5–8) are so very variable that scarcely any two are alike.

The *fore wing* varies greatly in shape. The outer border may be nearly at right angles to the lower border, as in the specimen figured (pl. 7, fig. 3), or it may make as large an angle with the lower border (pl. 7, fig. 6) as in the Chinese specimen figured (pl. 1) or in *P. m. hudsonianus* (pl. 3). The outer border may be straight (pl. 7, fig. 6), as in the specimen figured (pl. 2), or slightly, or even rather strongly (pl. 7, fig. 5) convex, the submarginal spots in the last case lying in a broad curve; it may be evenly curved (pl. 7, fig. 1), or straight in the anterior half and curving broadly inward in the posterior half (pl. 7, fig. 3) so that the lower angle of the wing is very broadly rounded. The apex is commonly more broadly rounded than in the specimen figured (pl. 2), though it may be more acute (pl. 5, fig. 5).

The dusting of light scales over the dark base of the fore wing is usually about the same as in the specimen figured, but is often less heavy, and the black outer margin of the dark base is usually broader within the cell, and often also beneath the cell (pl. 5, fig. 4). The submarginal yellow spots vary greatly in size, in some being larger (pl. 7, fig. 5) and in others smaller (pl. 5, fig. 3) than in the specimen figured. The black border is usually broader posteriorly than anteriorly, but in one specimen (pl. 7, fig. 5) its inner edge is parallel with the outer edge of the wing. It is usually about as in the specimen figured (pl. 2), but it may be broader (pl. 5, fig. 2; pl. 7, fig. 2), though not so broad as in the Chinese specimen shown (pl. 1.). The band across the middle of the outer half of the cell is often less regular (pl. 7, figs. 1, 4, 5) than in the specimens figured (pl. 2). It may be wedge-shaped with the lower end less than half as broad as the costal end or even narrower (pl. 7, fig. 1); the distal (adapical) border is commonly rather broadly excavated at about the middle (pl. 5, fig. 1), while there may be a smaller and more angular indentation on the proximal border near the lower end (pl. 7, figs. 3, 4). If both of these indentations are developed (pl. 7, fig. 5) the lower half of the band becomes chevron-shaped with the angle directed apically and the lower end very narrow.

On the under side the fore wing is in all cases essentially as in the specimen figured (pl. 2, fig. 2); the marginal light band is sometimes narrower (pl. 6, fig. 3), or even slightly broader (pl. 8, fig. 5), and the dark band just within it varies considerably in relative width (compare figs. 2 and 6, pl. 8).

The *hind wing* is always narrow, though sometimes a little broader than in the specimen figured. The indentations along the outer border are usually less deep than in the specimen figured, and are often slight (pl. 7, fig. 6). The tails vary greatly in length. They are seldom so long as in the specimen figured (pl. 2), in which the distance from the tip of the tail to the deepest portion of the scallop just above its base is nearly one-third greater than the distance between the tips of the veins on either side of the tail. In a few specimens the distance from the tip of the tail to the deepest part of the scallop just above the base is considerably less than the distance between the tips of the veins on either side of the tail (pl. 7, fig. 2), and rarely the base of the tail is broadened (pl. 7, fig. 1) so that it resembles the tail of *P. m. hudsonianus* as figured by Holland.

The dark outer border of the wing sometimes touches the end of the cell at the lower radial vein (pl. 5, fig. 6), and the section of the lower radial between the end of the cell and the dark border is in all the specimens except one from the Ramparts (pl. 5, fig. 3; referable to *petersii;* see beyond) markedly shorter than the dark bar at the end of the cell between the lower and upper radials; in this specimen it is only very slightly shorter. The inner edge of the dark border may be broadly and fairly evenly curved, as in the specimen from the Ramparts just mentioned, or it may be only slightly curved (pl. 5, fig. 1), or it may be broadly bowed in the middle (pl. 7, fig. 6), or just below the middle (pl. 7, fig. 4), becoming straighter at the two ends. In some specimens the inner edge of the border is much more convex in the interspaces than it is in others. The blue spots are usually somewhat larger than in the specimen figured, and may be considerably larger, almost touching the lunules (pl. 5, fig. 1); they are usually well defined and rather dense, but occasionally are poorly defined and obscure (pl. 7, fig. 1). The submarginal lunules vary considerably in size; they are usually larger than in the specimen figured (pl. 2), sometimes much larger (pl. 7, fig. 5) with broadly truncated ends. The dark abdominal border is very extensive; the yellow triangle at its lower end with its base resting on the black border of the ocellus is usually about as long as the diameter of the ocellus, though it may be shorter (pl. 5, fig. 2), and is often somewhat longer, rarely twice as long (pl. 7, fig. 4), so that its apex is not far below the origin of vein M_1. The anal ocellus is always light in color, with a blue metallic crescent, usually rather narrow though sometimes broad as in the specimen figured, separating it from the uniform and rather narrow black band just above. In some specimens the crescent is indefinitely edged beneath in its outer half with dark scales (pl. 5, fig. 6), and rarely this indefinite edging is more or less complete, suggesting a

distant approach to the condition found in Asiatic specimens (pl. 1, fig. 1). In one specimen (pl. 5, fig. 1), the lateroposterior narrow black edging of the orange spot is abruptly expanded at the end, the swollen end lying almost entirely within the lower portion of the ocellus as in *P. m. hudsonianus* (pl. 3).

On the under side of the hind wings the marginal lunules are very variable in size, and in most of the specimens are larger than in the one figured (pl. 2, fig. 2). In the specimen (pl. 5, fig. 3; pl. 6, fig. 3) with the dark border narrowest on the upper surface (referred above to *petersii*) the inner margin of the dark border below is similar to that in the type specimens of *petersii* and of *hudsonianus*. In the other specimens it varies from the condition seen in the type specimen of *petersii* to the condition seen in the specimen of *aliaska* figured (pl. 2, fig. 2), being in most cases about halfway between the two.

Comparisons.—As is evident from the figures, *P. m. aliaska* resembles *P. m. sikkimensis* more closely than it does *P. m. hudsonianus*. As was pointed out by Edwards in 1882, both *aliaska* and *sikkimensis* are strongly melanic. Both have the dark border of the hind wings above broad, nearly reaching the cell, but narrow below, where the inner border is formed of widely discontinuous black lines, and both have a broad submarginal band instead of a row of isolated spots on the under side of the fore wings. Specimens from the mountains of western China (pl. 1, figs. 1, 2) are more or less intermediate between the two, and Doctor Holland is probably correct in reporting *aliaska* from northeastern Asia.

As it occurs in Tibet and western China, *sikkimensis* is always readily distinguishable from *aliaska* by having the orange anal ocellus edged above with a broad black border including a thin blue crescent. In *aliaska* the blue crescent usually lies partly on the lower half of the rather broad black border and partly on the upper portion of the ocellus itself; but it may lie entirely on the black border, or it may have a poorly defined proximal border, scattered blue scales occurring over the upper half of the ocellus.

SUMMARY

In northern North America *Papilio machaon* is represented in the region between Hudson and James Bays and Lake Superior by a relatively large short-tailed form, *P. m. hudsonianus*, much like typical *P. m. machaon* from northern Europe, which appears to show but little variation.

In Alaska, Yukon, southwestern Mackenzie, and northwestern British Columbia there is a second form, *P. m. aliaska*, most closely related to a group of Asiatic forms of which *P. m. sikkimensis* may be taken as an example. Judged from the meager information avail-

able, this form appears to be well defined and stable throughout the greater part of its range; but in central Alaska it becomes very variable, and with it is found a third form, *P. m. petersii*, which approaches the Kamchatkan *P. m. kamtschadalus*, being intermediate between *P. m. hudsonianus* and *P. m. kamtschadalus*. Although *P. m. petersii* is very different from typical *P. m. aliaska*, the two seem to intergrade in the region in which both occur.

KEY TO THE AMERICAN SUBSPECIES OF PAPILIO MACHAON

a^1. Dark border of hind wings broad, the distance from the inner margin of the border to the black bar at the end of the cell less than the length of the bar; dark border of hind wings beneath narrower than above, the black lines in the interspaces delimiting the dark border interiorly widely discontinuous except for the two uppermost; tails of hind wings moderate in length or rather long, the distance from the tip of the tail to the deepest portion of the scallop just above its base being greater than the distance between the tips of the veins on either side of the tail; outer border of fore wings approximately straight; dark markings above black; Plate 2 (Alaska and adjacent portions of Yukon and Mackenzie) ---------- **aliaska.**

a^2. Dark border of hind wings narrower, the distance from the inner margin of the border to the black bar at the end of the cell greater than the length of the bar; dark border of hind wings beneath not narrower than above, the black lines in the interspaces delimiting the dark border interiorly almost continuous; tails of hind wings short, their length from the tip to the deepest portion of the scallop just above their base being considerably less than the distance between the tips of the veins on either side of the tail; outer border of fore wings distinctly convex; dark markings above brown.

b^1. Larger, the fore wing about 40 mm long; submarginal spots on lower surface of fore wing rounded and entirely distinct from each other; submarginal lunules on under side of hind wings of moderate size, the inner edge of the second and third from the costal border lying much less than halfway from the outer edge of the interspace to the inner margin of the dark border; posterior portion of the black margin of the orange anal ocellus expanded into a broad oval patch deeply encroaching on the ocellus; Plate 3 (Hudson Bay to Lake Superior) ---------- **hudsonianus.**

b^2. Smaller, the fore wing about 37 mm long; fore wings below with a broad light submarginal band crossed by dark hair lines at the veins; submarginal lunules on lower side of hind wings large, the inner edge of the second and third from the costal border lying halfway between the outer edge of the interspace and the inner margin of the dark border; lateral and posterior narrow black edging of the orange anal ocellus of uniform width, the ocellus being circular; Plate 4 (central Alaska) ---------- **petersii.**

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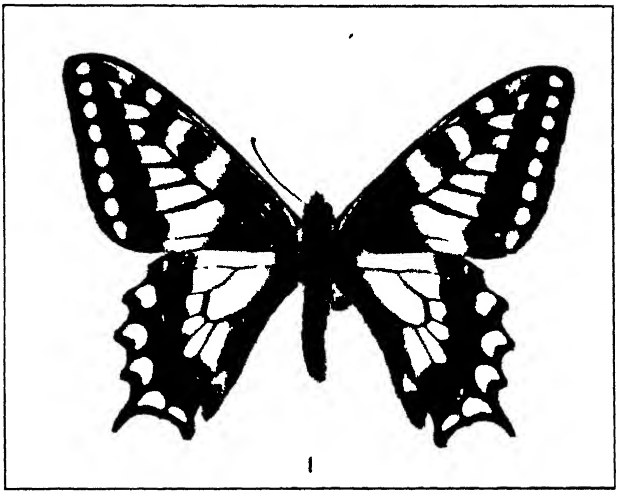
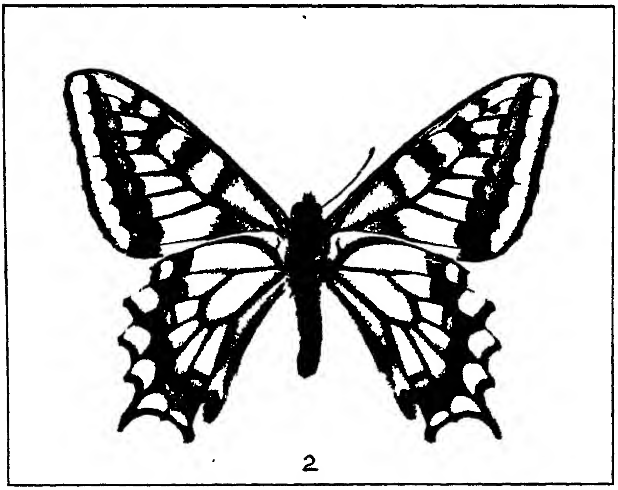




PAPILIO MACHAON SIKKIMENSIS

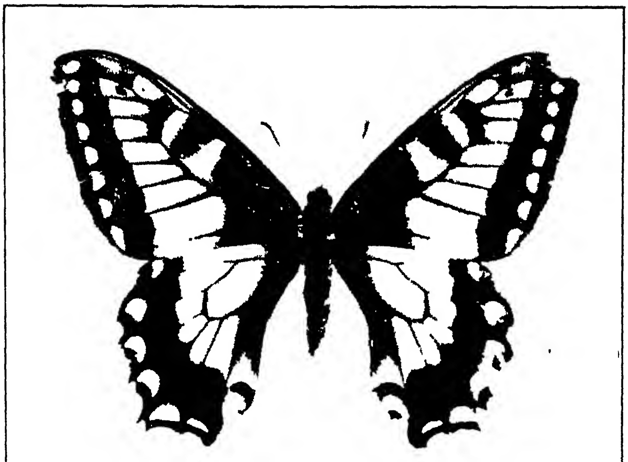
1, 2. Upper (1) and under (2) sides of a specimen, male, from Tatsienlu, Province of Szechwan, western China (lat. 30° N.), taken by native collectors in 1910.

1

2

PAPILIO MACHAON ALIASKA

1 2 Upper (1) and under (2) sides of a specimen male from Alaska taken on June 29 1921 (Barnes collection)



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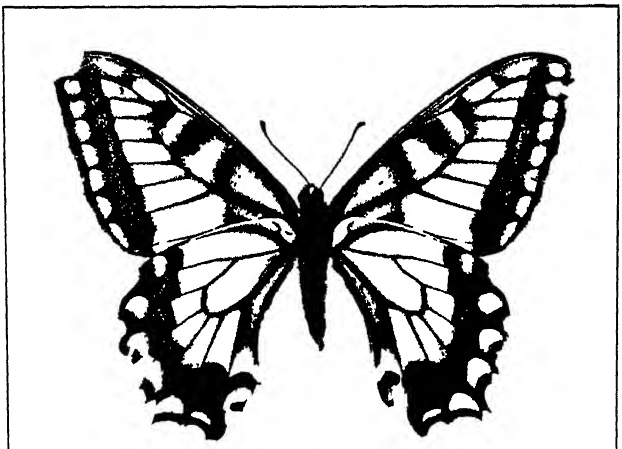
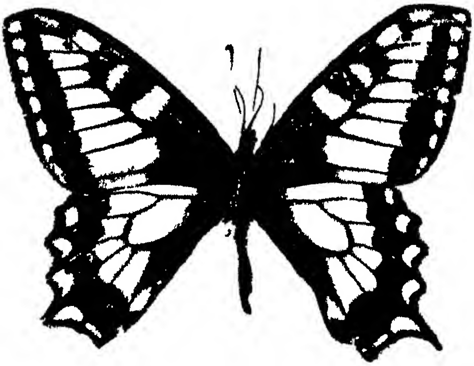


2

PAPILIO MACHAON HUDSONIANUS

1, 2. Upper (1) and under (2) sides of the type specimen, female, from Kettle Rapids, Nelson River, Manitoba, taken on July 8, 1914 (Barnes collection, U.S.N.M. No. 34478).



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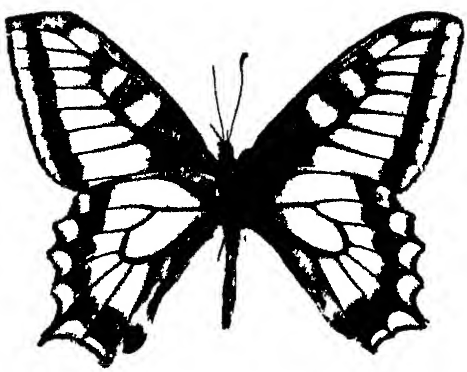
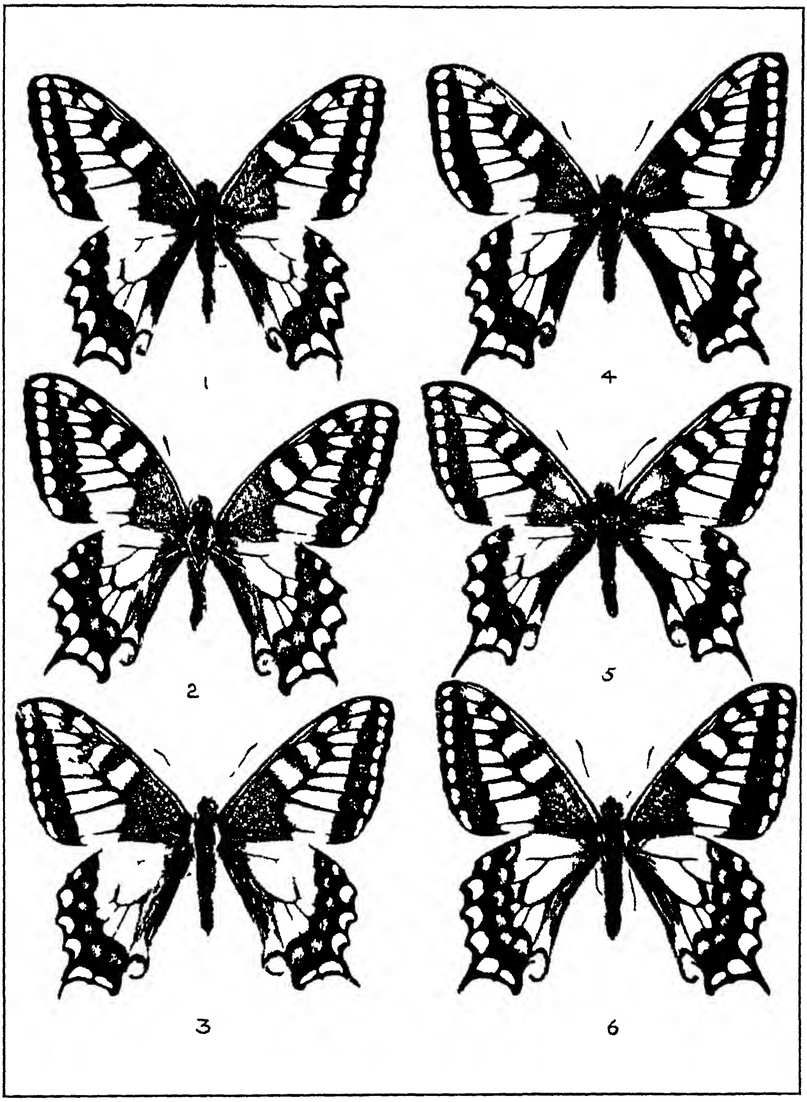


2

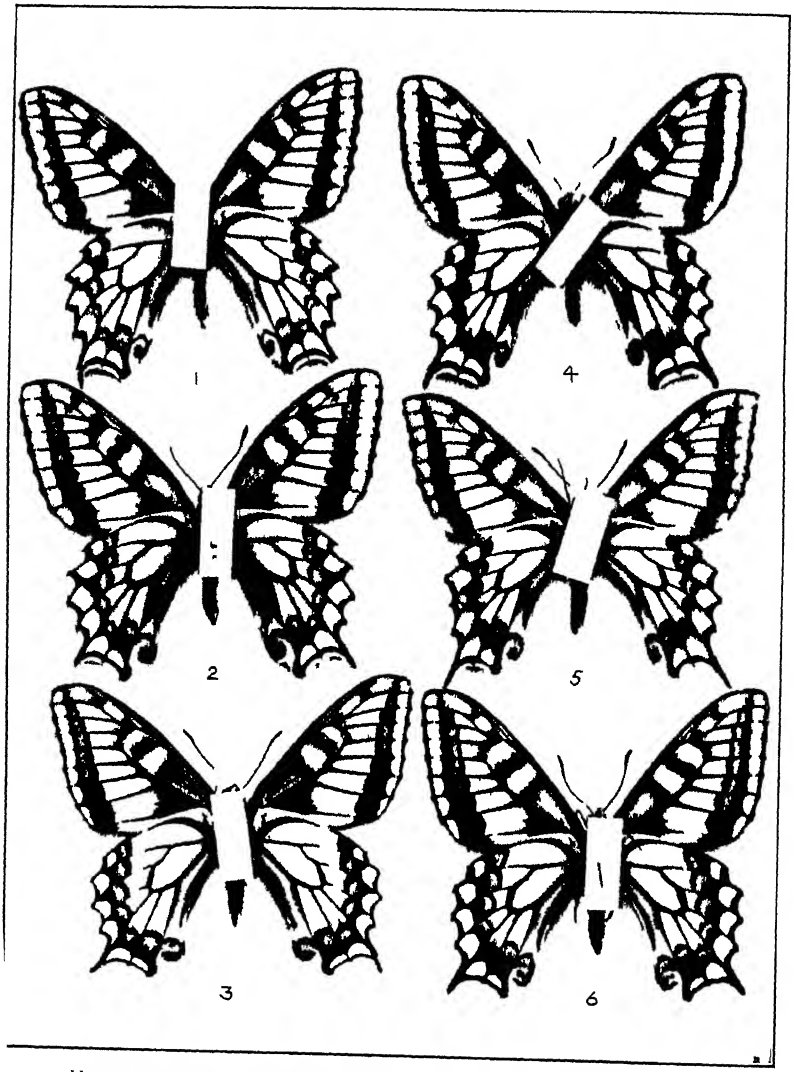
PAPILIO MACHAON PETERSII

1, 2 Upper (1) and lower (2) sides of the type specimen, male, from the Koyukuk River, Alaska (lat 67°–69° N, long 151° W), W J Peters, 1901 (U S N M No 34479)

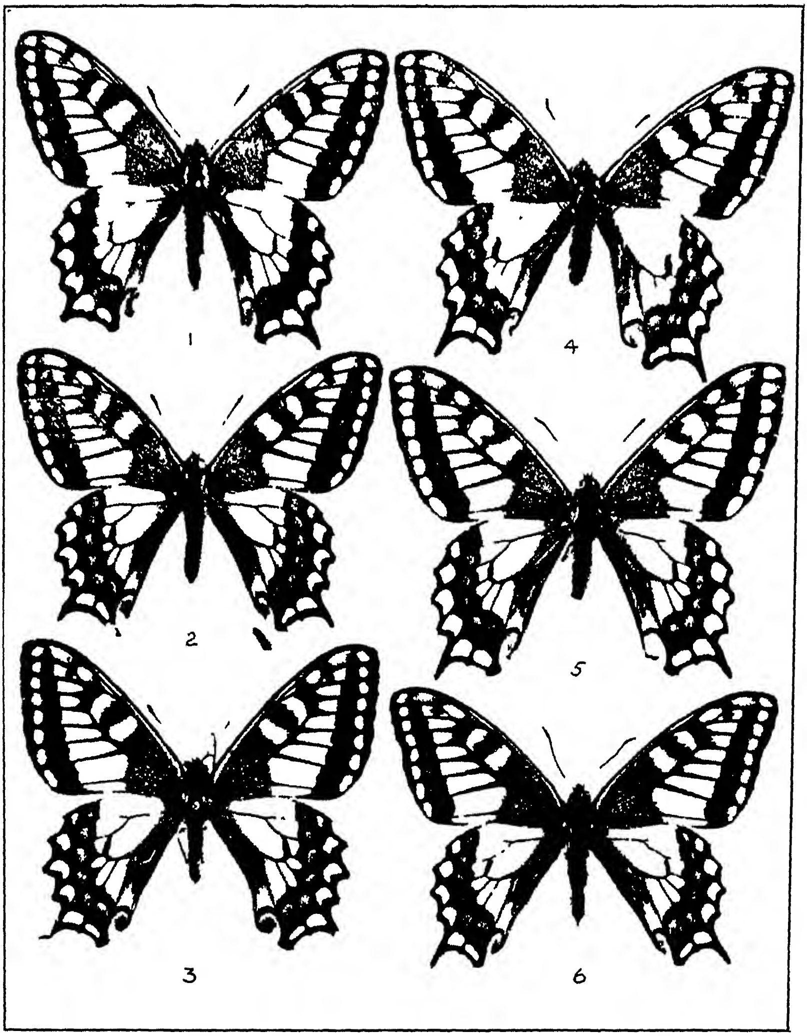


PAPILIO MACHAON ALIASKA AND P M PETERSII

1, 2, 4-6 *Papilio machaon aliaska*, males, from the Ramparts on the middle Yukon, Alaska, taken at an altitude of 1,000 to 3,000 feet in June, 1922 3, *P m petersii* male, from the same locality Slightly reduced Courtesy of the Zoological Museum, Tring, England, through Dr Karl Jordan

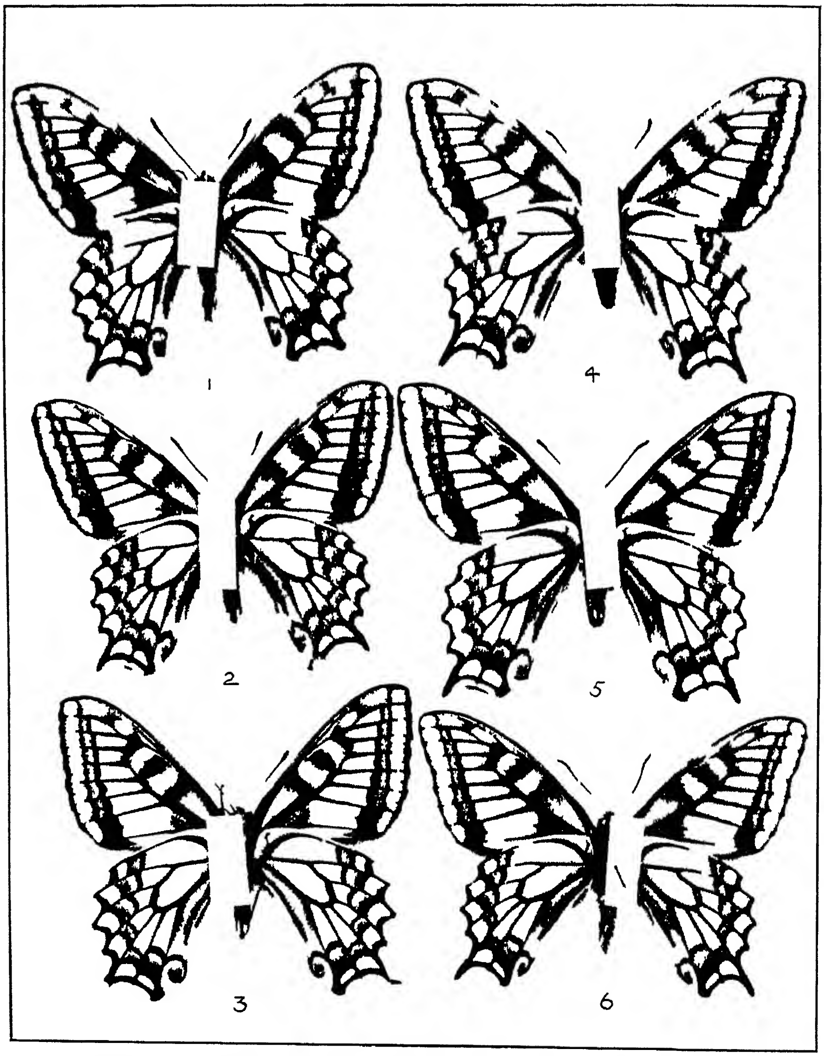


UNDERSIDES OF SPECIMENS SHOWN ON PLATE 5 RESPECTIVELY



PAPILIO MACHAON ALIASKA

1-6. Males from the same locality as those shown on Plate 5 Slightly reduced. Courtesy of the Zoological Museum, Tring, England, through Dr. Karl Jordan.



UNDERSIDES OF SPECIMENS SHOWN ON PLATE 7 RESPECTIVELY

REPORT ON THE HEXACTINELLID SPONGES COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" IN THE NORTHWESTERN PACIFIC DURING THE SUMMER OF 1906

BY

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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
WASHINGTON, D. C.
1932

REPORT ON THE HEXACTINELLID SPONGES COLLECTED BY THE UNITED STATES FISHERIES STEAMER "ALBATROSS" IN THE NORTHWESTERN PACIFIC DURING THE SUMMER OF 1906

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Zoological Institute, Tokyo University of Science and Arts, Tokyo, Japan

The large number of hexactinellid sponges collected by the United States Fisheries steamer *Albatross* during her cruise in the northwestern Pacific Ocean in 1906 were originally assigned for study and report to the late Professor Ijima by the United States Bureau of Fisheries. Two years before his death, in March, 1920, the specimens were placed in my hands for joint report with Doctor Ijima, at which time the material had been practically untouched. With the permission of the Bureau of Fisheries, I have worked up this valuable collection and prepared this report upon it. To that bureau I tender my best thanks. I also extend my thanks to the late Professors Ijima and Watasé and to Professor Yatsu, who have kindly given me a table in the Zoological Institute; to Dr. S. Hôzawa for his many valuable suggestions; and to two American colleagues, Dr. Waldo L. Schmitt, of the United States National Museum, and Dr. Carl L. Hubbs, of the University of Michigan, for assistance in seeing the manuscript through the press.

The specimens are referable to 42 species and 7 subspecies belonging to 17 genera and 3 subgenera. Owing to the imperfectness of the specimens the following material, mentioned elsewhere herein, could not be specifically determined: Hyalonematids, *Farrea* sp., *Aphrocallistes* sp., *Bathydorus* species? α and β.

Twenty-nine species and subspecies, as follows, are new to science:

Pheronema globosum kagoshimensis, page 6.
Pheronema ijimai, page 8.
Pheronema surugensis, page 13.
Hyalonema (Cyliconema) apertum solidum, page 21.
Hyalonema (Cyliconema) hozawai, page 22.
Hyalonema (Coscinonema) kirkpatricki globosum, page 26.
Hyalonema (Coscinonema) ovatum, page 26.

The stations where the hexactinellids reported upon were obtained are listed in Table 1:

TABLE 1.—*Stations in northwestern Pacific where hexactinellids were obtained*

Station No.	Date	Approximate location	Latitude and longitude	Depth	Temperature	Nature of bottom	Species collected
	1906			*Fathoms.*	°*F.*		
4768	June 3	"Bowers Bank" Bering Sea.	54° 20′ 30″ N., 179° 09′ 30″ E. (approx.).	764	36.5	Greenish-brown mud, fine black sand.	Indeterminable Farrea.
4769	...do...	...do...	54° 30′ 40″ N., 179° 14′ E. (approx.).	244	38.5	Gray sand, green mud.	Aulosaccus tuberculatus, A. fissuratus, Rhabdocalyptus borealis, Bathydorus β sp.
4770	...do...	...do...	54° 31′ N., 179° 15′ E. (approx.)	247	......	......	Rhabdocalyptus heteraster, Bathydorus β sp.
4771	June 4	...do...	54° 30′ N., 179° 17′ E.	426	......	Broken shells.	Staurocalyptus rugocruciatus.
4772	...do...	...do...	54° 30′ 30″ N., 179° 14′ E.	344	38.1	Greenish brown sand.	Rhabdocalyptus australis, R. borealis.
4775	...do...	...do...	54° 33′ 30″ N., 179° 44′ E.	584	......	Green mud, black specks, foraminifera.	Aulosaccus fissuratus.
4780	June 7	Near western extremity of Aleutian Islands.	52° 01′ N., 174° 39′ E.	1,046	35.9	Gray mud, sand, pebbles.	Aphrocallistes aleutiana.
4781	...do...	...do...	52° 14′ 30″ N., 174° 13′ E.	482	38.6	Fine gray sand, pebbles.	Aphrocallistes yatsui, Aulosaccus fissuratus, Rhabdocalyptus unguiculatus.
4790	June 14	Near Bering Islands, Bering Sea.	54° 38′ 45″ N., 167° 11′ 45″ E.	64	41	Pebbles.	Farrea beringiana, Hyalascus attenuatus, Aulosaccus pinularis.
4797	June 20	Near Petropavlovsk, Staritschkof Island.	52° 37′ 30″ N., 158° 50′ E.	682	36.6	Green mud, coarse black sand, broken shells.	Farrea watasei, Aulosaccus albatrossi.
4803	June 24	SE. of Shimushir Island, Kuriles.	46° 42′ N., 151° 44′ E.	229	35.9	Coarse pebbles, black sand.	Aphrocallistes intermedia, Aulosaccus schulzei, A. fissuratus shimushirensis, Acanthascus pachyderma.
4804	...do...	...do...	46° 42′ N., 151° 47′ E.	229	35.9	...do...	Farrea kurilensis, Aphrocallistes intermedia, Aulosaccus solaster, Hyalascus attenuatus.
4876	Aug. 2	Eastern channel of Korea Strait, vicinity of Oki Islands.	34° 20′ N., 130° 10′ E.	59	62.1	Fine gray sand, broken shells.	Euplectella oweni.
4878	...do...	...do...	34° 18′ 30″ N., 130° 14′ 30″ E.	59	......	...do...	Do.
4890	Aug. 9	10 to 20 miles SW. of Gotô Islands, Ôsezaki.	32° 26′ 30″ N., 128° 36′ 30″ E.	135	52.3	Rocks.	Eurete farreopsis, E. sacculiformis, Aphrocallistes beatrix orientalis.
4893	...do...	...do...	32° 32′ N., 128° 32′ 50″ E.	106	55.9	Gray sand, broken shells, pebbles.	Pheronema ijimai, Eurete nipponica.

TABLE 1.—*Stations in northwestern Pacific where hexactinellids were obtained*—Continued

Station No.	Date	Approximate location	Latitude and longitude	Depth	Temperature	Nature of bottom	Species collected
				Fathoms.	° *F.*		
4894	Aug. 9	10 to 20 miles SW. of Gotô Islands, Ôsezaki.	32° 33′ N., 128° 32′ 10″ E.	95	......	Green sand, broken shells, pebbles.	Aphrocallistes beatrix orientalis.
4895	...do...	...do...	32° 33′ 10″ N., 128° 33′ 20″ E.	95	......	...do...	Do.
4900	Aug. 10	...do...	32° 28′ 50″ N., 128° 34′ 40″ E.	139	52.9	Gray sand, broken shells.	Semperella schulzei.
4903	...do...	...do...	32° 31′ 10″ N., 128° 33′ 20″ E.	139	......	...do...	Do.
4911	Aug. 12	10 to 20 miles SW. of Koshiki Islands, Tsurikake Saki.	31° 38′ 30″ N., 129° 19′ E.	391	41.9	Gray globigerina ooze...	Indeterminable Hyalonema.
4915	...do...	...do...	31° 31′ N., 129° 25′ 30″ E.	427	......	...do...	H. (Cyliconema) apertum.
4917	Aug. 13	About 90 miles WSW. of Kagoshima Gulf.	30° 34′ N., 129° 06′ E.	361	......	Gray sand, globigerina, broken shells.	Sericolophus reflexus, Bathydorus a sp.
4919	...do...	Kusakaki Jima...	30° 34′ N., 129° 19′ 30″ E.	440	41.8	Globigerina ooze...	Hyalonema (Cyliconema) apertum solidum, Sericolophus reflexus.
4920	...do...	...do...	30° 34′ N., 129° 22′ E.	440	41.8	...do...	Sericolophus reflexus.
4924	Aug. 14	18 miles SW. of Yakushima, Nagada Saki.	30° 5′ N., 130° 21′ 22″ E.	159	55.8	Rocks...	Farrea sollasii yakushimensis.
4929	Aug. 15	10 miles S. of Yakushima...	30° 12′ 30″ N., 130° 43′ E.	84	74.8	Broken shells, coral, pebbles.	Do.
4933	Aug. 16	Sata Misaki, off Kagoshima Gulf.	30° 59′ N., 130° 29′ 50″ E.	152	56	Rocks...	Pheronema giganteum.
4934	..do...	...do...	30° 58′ 30″ N., 130° 32′ E.	103	......	Rocks...	Pheronema ijimai, Semperella schulzei, Aphrocallistes beatrix orientalis, Eurete farreopsis, Lanuginella pupa.
4936	...do...	...do...	30° 54′ 40″ N., 130° 37′ 30″ E.	103	......	Stones...	Pheronema globosum kagoshimensis, Crateromorpha meyeri rugosa.
4937	...do...	In Kagoshima Gulf, Chirin Jima.	31° 13′ N., 130° 43′ 10″ E.	58	64.8	Mud, lava, pebbles...	Aphrocallistes beatrix orientalis.
4948	Aug. 21	East of Hiuga, Ôshima...	31° 19′ N., 131° 23′ E.	65	62.6	Dark gray volcanic sand, broken shells, pebbles	Euplectella oweni.
4956	Aug. 23	Off entrance to Bungo Channel, Mizunoko Jima.	32° 32′ N., 132° 23′ E.	720	37.5	Greenish-brown mud, fine gray sand, foraminifera.	Hyalonema (Coscinonema) kirkpatricki globosum, H. (Cyliconema) hozawai.

4957	...do.....	Off east coast of Kyûshû....	32° 36′ N., 132° 23′ E.	437	39.8	....do	Hyalonema (Cyliconema) apertum solidum, Hyalonema (Coscinonema) kirkpatricki globosum.
4958	...do....	.....do	32° 36′ 20″ N., 132° 24′ 30″ E.	405	40.1	.....do	Hyalonema (Corynonema) owstoni.
4959	...do....	.....do	32° 36′ 30″ N., 132° 24′ 30″ E.	...do...	.....	.....do	Hyalonema (Cyliconema) apertum solidum.
4976	Aug. 30	SW. of Shiomisaki in Kii....	33° 22′ 50″ N., 135° 38′ 30″ E.	545	38.7	Brown mud, small stones.	Hyalonema (Corynonema) owstoni.
5030	Sept. 29	About midway between south end of Sagkalin and Eturup Island.	46° 29′ 30″ N., 145° 46′ E.	1,800	35.4	Brown mud	Eurete irregularis.
5069	Oct. 15	Entrance to Enoura, Suruga Gulf, Isezaki.	35° 03′ 10″ N., 138° 47′ E.	131	55.8	Mud, sand, broken shells.	Indeterminable Hyalonema, Eurete schmidtii, Crateromorpha corrugata.
5070	...do.....	.....do	35° 03′ 25″ N., 138° 47′ 40″ E.	108	57.6	.....do	Eurete schmidtii.
5083	Oct. 20	34.5 miles nearly SSW. of Omaizaki.	34° 04′ 20″ N., 137° 57′ 30″ E.	624	38.1	Fine gray sand, globigerina.	Sericolophus reflexus.
5084	...do.....	.....do	34° N., 137° 49′ 40″ E.	918	36.8	Green mud, fine sand, globigerina.	Pheronema surugensis, Hyalonema (Coscinonema) ovatum.
5085	Oct. 23	Sagami Bay, Jôgashima.....	35° 06′ 45″ N., 139° 19′ 05″ E.	622	37.8	Green mud, fine black sand.	Chaunoplectella spinifera.
5087	...do.....	.....do	35° 09′ 40″ N., 139° 19′ 05″ E.	614	37.5	Green mud	Rhabdocalyptus bidentatus.
5088	Oct. 25	.....do	35° 11′ 25″ N., 139° 28′ 20″ E.	369	41.8	.....do	Periphragella elisae, Acanthascus cactus.
5090	Oct. 26	Entrance to Uraga Strait, between Jôgashima and Okinosé.	35° 03′ 50″ N., 139° 37′ 30″ E.	200	47.6	Pebbles, black sand.....	Indeterminable Aphrocallistes?, Rhabdocalyptus victor.
5091	...do.....	.....do	35° 04′ 10″ N., 139° 38′ 12″ E.	197	47.6	Green mud, coarse sand, pebbles.	Farrea sollasii.
5092	...do.....	.....do	35° 04′ 50″ N., 139° 38′ 18″ E.	70	56.3	Coarse black sand......	Aphrocallistes beatrix orientalis.

Suborder AMPHIDISCOPHORA F. E. Schulze, 1899

Family PHERONEMATIDAE J. E. Gray, 1870

Genus PHERONEMA Leidy, 1868

PHERONEMA GIGANTEUM F. E. Schulze

Pheronema giganteum F. E. SCHULZE, Rep. Voy. *Challenger*, vol. 21, pp. 250–254, pl. 45, figs. 1–11, pl. 46, figs. 1–11, 1887; Sitzber. kon. preuss. Akad. Wiss. Berlin, 1893, p. 563.—IJIMA, *Siboga*-Expeditie, vol. 6, pp. 10–17, pl. 5, figs. 1–7, 1927.

Two specimens of this species were obtained from the same station, No. 4933, off Kagoshima Gulf, at a depth of 152 fathoms. Of these, one is of a complete, large globular form and is beset with numerous prominently protruded bundles of cuspidates, which attain a length of 45 mm beyond the sponge dermal surface. The sponge body measures 80 mm in height and 68 mm in maximum diameter. The external surface of the skin, as seen between the laterally projecting tufts of spicules, appears to the naked eye very uniform and even. The osculum is nearly circular and measures 9 mm in diameter; its margin is not raised and it is entirely free from such marginalia as seen in the *Challenger* specimen. The gastral cavity, which attains a depth of 30 mm, is narrow, nearly smooth, and even on the surface.

The smaller specimen is incomplete, the upper half or more having entirely fallen off. The barrel-shaped mesamphidisk, as observed in the specimen of *Challenger* collection, seems to be entirely absent over the body of the sponge in hand.

A cuspidate, larger than any described for this species by previous authors, occurs more rarely, intermixed with the other cuspidates. It measures 2 mm long or more and 40μ to 50μ broad at the middle, attenuating gradually toward the distal end protruding from the sponge body. The surface of the spicule is covered with prominent short spines projected directly toward both lateral sides. Their sizes increase toward the distal end of the spicule, which is beset with two prominent distally directed spines on each side, and diminish toward the proximal end, imbedded in the spongy body.

In most particulars of the spiculation, the present specimens are quite similar to those of the *Siboga* expedition and show features somewhat different from the *Challenger* specimen.

PHERONEMA GLOBOSUM KAGOSHIMENSIS, new subspecies

PLATE 1, FIGURE 4

A large complete specimen (holotype, U.S.N.M. No. 22026), for which I establish this new form, was collected from a spot off

Kagoshima Gulf, at a depth of 103 fathoms (Station 4936). It is closely allied to the type of the species in essential characters but differs from it chiefly by having an ovoid mesamphidisk and a different kind of large uncinate. The sponge has the shape of a radish, its maximum transverse diameter at the upper end much exceeding its height; it measures 51 mm, becoming somewhat attenuated below and measuring 33 mm at the base. The oscular margin is nearly circular, with an axis of 35 mm. The upper surface is occupied by a concave sieve plate, the margin of which forms a slightly raised and sharpened edge, from which the short and weak marginal cuspidates protrude in a single row. The lateral cuspidates, which project radially from several points on the sides of the sponge, form small bundles each of several spicules. Most of these are stout and, grouped together, form a small strand protruding several centimeters from the body surface.

The root tuft is about 35 mm long. The basalia composing it are arranged in a large bundle 23 mm thick. The upper ends of these spicules, which are smooth and gradually drawn to a point, are imbedded in the sponge for a length of several centimeters. Their much longer free part extends more or less obliquely downward. The basalia have two teeth rising from the gently bow-shaped, rounded, and thickened terminal portion, and end in simple conical points. The distance between these two terminal points—that is, the total breadth of the anchor—is 0.35 mm to 5 mm. The shaft becomes gradually narrower to within a certain distance of the end of the anchor, and then increases in thickness on the anchor itself.

In the present specimen the distal ray of the dermal pinules on the lateral side attains a length of 200μ, and that on the sieve plate, though similar to the dermal in shape, may be much longer than it. The four basal rays are longer than those of the type of the species, measuring 100μ. On some parts of the oscular sieve plate much shorter pinules, measuring 85μ, are found. In these the distal unpaired pinular ray is covered with moderately stout, conically pointed, and widely diverging spines, 52μ in breadth. The basal rays, which form a rectangular cross, are much longer, measuring 180μ to 200μ. They are stout and straight, and are often nearly covered distally with short spines. A slight curvature of the basal rays may sometimes appear on these pinules. The proximal ray is represented by a vestige in the form of a terminally pointed short tubercle.

As to the amphidisk, I have found moderately broad, nearly ovoid mesamphidisks, which are sparsely developed among the hypodermalia and parenchymalia. Among the latter they occur much more abundantly than among the former. Each spicule usually measures 80μ to 120μ in length and bears on each end 12 sharply pointed

umbel rays forming a distinct broad bell-shaped terminal disk, almost meeting the opposite one and attaining a breadth of 40μ to 56μ. The shaft is 4μ to 6μ thick and fairly rich in rounded tubercles on all surfaces. Macramphidisks sometimes attain a length of 190μ in the present specimen and have a bell-shaped terminal disk 45μ long and 56μ broad.

The large uncinates in the type of the species are not abundant; besides these, there is another form of large uncinates, similar to those seen in many members of Dictyonina. On these the spines are short, straight, and very oblique, nearly parallel, and closely applied to the shaft.

TABLE 2.—*Comparison of* Pheronema globosum *Schulze and* P. g. kagoshimensis, *new subspecies*

Form	Collected	Pinules on dermal lateral wall		Pinules on sieve plate	
		Distal ray	Basal ray	Distal ray	Basal ray
		Length in μ	*Length in μ*	*Length in μ*	*Length in μ*
Pheronema globosum (type)	Little Kii Islands by Challenger	150	60	-------	-----
P. g. kagoshimensis	Off Kagoshima Gulf, 103 fathoms, by Albatross	160–200	60–100	(1)	(2)

Form	Collected	Macramphidisk		Mesamphidisk		Uncinates	
		Length in μ	Width in μ	Length in μ	Width in μ	Large	Small
							μ
Pheronema globosum (type)	Little Kii Islands by Challenger	60	40	-------	-------	----	120
P. g. kagoshimensis	Off Kagoshima Gulf, 103 fathoms, by Albatross	160–185	55–65	80–120	40	----	120–250

[1] Mostly 180–240, infrequently 85 [2] Mostly 80–100, infrequently 200

PHERONEMA IJIMAI, new species

FIGURE 1; PLATE 2, FIGURE 1

The four complete specimens for which I establish this new species are nearly allied in outer configuration. The largest one, which I shall designate with the letter A (holotype, U.S.N.M. No. 22027), was collected from a spot 10 to 20 miles southwest of the Gotô Islands, at a depth of 106 fathoms (Station 4893). The remaining three specimens (B–D) were found off Kagoshima Gulf at 103 fathoms (Station 4934). Specimen A is a circular ball-like mass, abruptly narrowed terminally, 43 mm high, and 37 mm broad at the center. The nearly elliptical osculum measures 5 mm by 3.5 mm.

The sieve plate is entirely lacking. The gastral chamber is very shallow and small, measuring only 8 mm in depth. The root tuft projecting from the basal surface is curled. The prostal marginalia

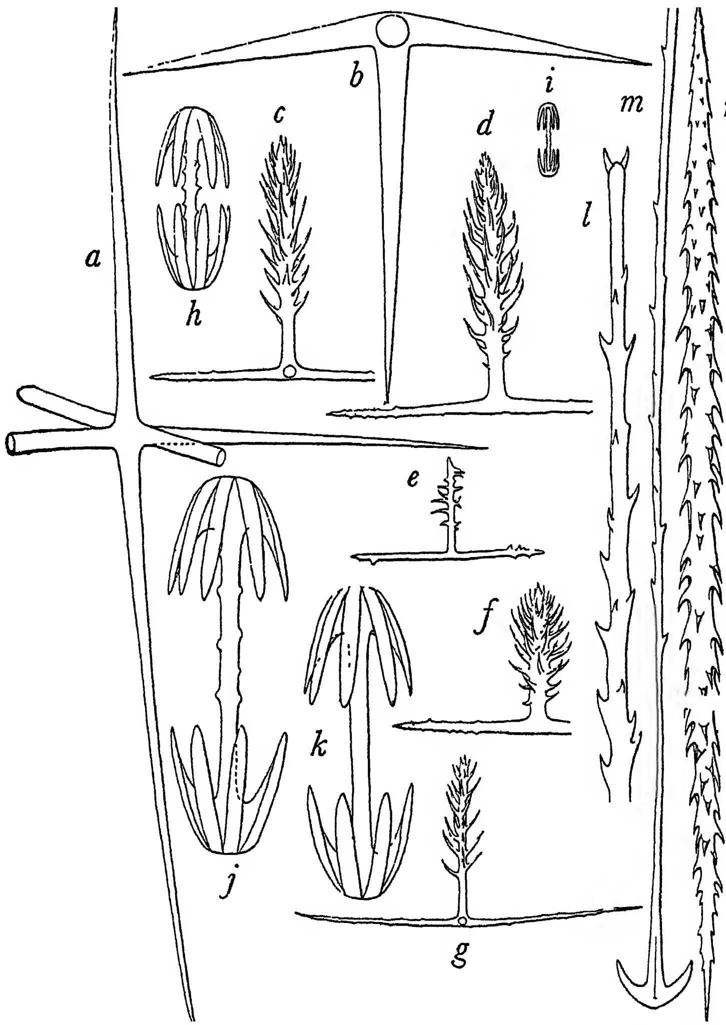


FIGURE 1.—*Pheronema ijimai*, new species: *a*, Parenchymal hexactin, × 125; *b*, hypodermal pentactin, × 125; *c*, dermal pentactinic pinule, × 250; *d*, dermal pentactinic pinule, × 250; *e*, young pentactinic pinule, × 250; *f*, gastral pentactinic pinule, × 250; *g*, gastral pentactinic pinule, × 250; *h*, mesamphidisk, × 250; *i*, micramphidisk, × 250; *j*, macramphidisk, × 250; *k*, mesamphidisk, × 250; *l*, cuspidate, × 250; *m*, basalia, × 250; *n*, macrouncinate, × 250

are very inconspicuous. Specimen B, the smallest of all, has a nearly egglike form and is 26 mm in breadth and 16.5 mm in height. The circular osculum measures 2 mm in diameter. Specimen C represents an entire ball-like body, having at its apical end a nearly oval

osculum, measuring 3 mm in diameter. Specimen D is a compound body potatolike in form and provided with three circular oscular apertures measuring 2 mm on the top, two of which open close together, while the third one is situated somewhat apart from the others.

All the specimens labeled B to D have numerous weak, short, prostal lateralia protruding from the entire surface of the body, and the basal tuft is not prominently formed. The basal anchor spicules project separately from the basal surface.

Spiculation.—The numerous radial cuspidates (fig. 1, *l*), projecting a very short distance beyond the surface of the sponge, are long spicules, thickly covered with pointed microspines on the proximal surface imbedded in the sponge wall and becoming gradually sparser and larger toward the apex. They occur on all surfaces, especially at the basal regions of the body and are always radially disposed, so that the pointed ends of the bars are directed inward and the anterior point of the whole spicule outward. The distal end, somewhat expanded to a globular form, is provided laterally with two short spines projecting slightly outward. I have found only one specimen (D) in which these protruding spicules are much stouter, longer, and arranged in a bundle; they usually project singly.

The root spicules (fig. 1, *m*) do not form a tuft; they protrude singly from the basal surface of the sponge body, infrequently making a small curled bundle. These long, strongly developed spicules end internally in the body in a simple point; while, toward the lower and outer end, they first decrease gradually in thickness and then finally form a double-toothed, gently curved anchor. Two anchorlike teeth stand out almost at right angles from the shaft; are only slightly bent, and end in a somewhat blunt point. In specimens B to D, 25–37 mm in diameter, the basalia project singly; and, as the sponge grows, the spicules composing the basal tuft increase in number and in size.

The hypodermalia (fig. 1, *b*) are composed of the large pentactins supporting the dermal membrane; the four paratangentials lie mostly in a plane and extend tangentially to the radially arranged rays of starlike texture on the dermal surface, measuring 320μ to 1,700μ in length. The spicules vary greatly in size; the larger ones measure 105μ to 1,200μ along the proximal ray and 320μ to 1,700μ across the paratangential rays. The rays are quite smooth, and usually taper toward the sharp-pointed end, with a breadth of 16μ to 160μ at the base.

In certain parts of the dermal and gastral membranes, uncinates 1 mm to 3 mm or more in length and up to 16μ thick occur, some-

times forming a large bundle. These macrouncinates (fig. 1, *n*) are covered with spines, which protrude very obliquely and extend nearly parallel close to the surface of the shaft of spicules.

Pinules are found on the dermal and gastral membranes, much more sparsely on the latter. They usually stand close together, their basal rays extending parallel for considerable distances and forming a very irregular network. The dermal pinules (fig. 1, *c*, *d*) are 60μ to 80μ high, usually 65μ. The four basal rays are nearly always quite straight and form a regular cross with beams intersecting vertically. They vary from 100μ to 200μ long, averaging 140μ, and are 4μ thick, proximally smooth for a very short distance, and distally covered sparsely or thickly with either vertical or oblique spines, which are sharply pointed. The distal ray is vertical to the plane of the basal rays and consists of a smooth proximal part, 6μ thick and 10μ or more long, and a bushy, distal, nearly conical part covered with curved stout spines. This distal part is usually 50μ or more long and covered with stout, lateral spines, terminally only slightly curved and extended obliquely upward, proximally projecting almost transversely.

The gastral pinules (fig. 1, *f*, *g*) are somewhat different from those on the dermalia. The basal rays, measuring 180μ on an average, are a little longer than the distal ray, which measures 120μ to 160μ in length. Most of the pinules have a prominent, stout, terminal spine and lateral spines obliquely extended upward on both sides, so that the distal ray makes a distally expanded bushy tuft.

Besides these pentactinic pinules, there are infrequently hexactinic pinules on the dermalia. They have a sparsely spined and somewhat shorter distal pinular ray, which, as a whole, is narrow and feather-shaped, measuring 56μ on an average. The proximal ray is slightly shorter than the paratangential rays of the same pinule, measuring 68μ long and 4μ thick at the base, with sharply pointed end. It is beset with small, generally erect prickles, sparingly present or entirely absent at the base but more numerous at the end.

Among these pinules there are found much more delicate pinules, which may be younger or abnormal forms. These spicules may occur in ectosome and endosome as well as in choanosome; in the hexactinic pinules, the six rays are unequal, beset with several sharply pointed, echinated spines near the distal ends. The paratangentials are the longest of all, 100μ to 140μ in length, and 4μ thick at the base, gradually attenuating toward the sharply or conically pointed and somewhat curved end. The distal ray is the shortest and is covered with weak lateral spines on the distal part. The pentactinic pinules (fig. 1, *e*), which may occur together with the hexactinic ones, are nearly the same size. The distal unpaired ray usually measures 92μ long

and is echinated prominently, while the paratangential rays are somewhat curved and spined only distally, measuring 100μ to 140μ in length. The distal ray is represented by a vestige in the form of very short, terminally pointed spines.

Canalaria pinules are in this, as in other members of *Pheronema*, nearly entirely absent.

Amphidisks of three kinds—macramphidisks, mesamphidisks, and micramphidisks—are found in the dermalia and in the parenchymalia.

The macramphidisks (fig. 1, *j*) are 160μ to 220μ long and have bell-shaped terminal disks that attain a diameter of 68μ and a height of 63μ. The shaft is 8μ thick and roughened by a few round tubercles on the surface. Each disk has eight broad, spade-shaped, terminally slightly pointed marginal rays.

The mesamphidisks (fig. 1, *h*, *k*) are mostly distributed sparsely in the parenchymalia, and are beset with 8 to 12 slender terminally pointed marginal rays on the broad bell-shaped terminal disk, which attains a length of 90μ to 125μ and is 52μ in diameter. The shaft also has round tubercles on the surface and measures 8μ in breadth at the center.

The numerous micramphidisks (fig. 1, *i*) occur everywhere, and are especially abundant in the gastralia. They are 20μ to 40μ, rarely as much as 48μ, long. Their terminal disks are bell-shaped, about 10μ long and 8μ broad, and have 8 to 12 marginal teeth, which sometimes are not easy to observe distinctly. The shaft is rough and is beset with numerous sharply pointed microspines.

The microuncinates are very abundant in the parenchymalia and vary in length from 140μ to 230μ, becoming extremely attenuated toward the posterior end and covered with short stout spines, the basal part of which is nearly perpendicular to the shaft on the anterior part of the same spicule, and the distal part of which is strongly or weakly bent and hooklike in appearance.

Besides this microuncinate, there occur the other small uncinates, which are entirely similar to the above-mentioned large uncinates in shape and which vary considerably in size. It is therefore evident that the large and small uncinates of these forms are connected by transitional forms and do not seem essentially different from one another.

In the parenchymalia, the large robust hexactins and pentactins are found. The hexactinic parenchymalia (fig. 1, *a*) are seemingly of quite variable dimensions. Many rays are about 0.5 mm to 1.7 mm long and 80μ broad near the spicular center. They are usually smooth throughout the entire surface and taper gradually toward the sharply pointed end.

The pentactinic parenchymalia play a comparatively less important part in the composition of the parenchyme, as they are sparse. They occur mostly in loose strands running in company with the rays of hexactinic parenchymalia. They are also smooth on the surface and gradually or suddenly attenuated toward the sharply pointed end.

TABLE 3.—*Measurements of four specimens of* Pheronema ijimai

Specimen and condition	Collected at—	Dermal pinules		Gastral pinules		Macramphidisk	Mesamphidisk	Micramphidisk	Uncinates	
		Distal ray	Basal ray	Distal ray	Basal ray				Large	Small
		μ	μ	μ	μ	μ	μ	μ	*Mm*	μ
A (large, complete).	Station 4893, off Gotô Islands, 106 fathoms.	60–80	100–180	160	120–180	160–200	104	20–40	1. 3–2. 3	160–240
B (small, complete).	Station 4934, off Kagoshima Gulf, 103 fathoms.	60–70	140–170	120	128–195	180–200	90–104	20–48	1. 4–2. 2	140–240
C (small, complete).	do	60–80	130–180	140	160–180	180–220	125	20–48	1. 3–2. 4	140–230
D (small, complete).	do	60–80	160–200	(?)	(?)	160–200	(?)	20–46	1. 4–2. 2	(?)

PHERONEMA SURUGENSIS, new species

Two large fragments (U.S.N.M. No. 22028), very badly macerated and injured, which may be two parts of a tolerably large sponge body, were collected at Station 5084, nearly south by southwest of Omaizaki, Suruga Bay, at a depth of 918 fathoms.

Spiculation.—The prostal marginalia protruding from the oscular margin, the large and tolerably small uncinates with oblique spines, and the oxypentactins, supporting the interior of the sponge body, are to be considered as macroscleres.

The prostal marginalia, which are protruded from the oscular margin, are long cuspidates, straight or slightly curved, 10 mm to 20 mm or longer (protruding parts about 5 mm to 10 mm long), and 40μ thick at the center. Their distal parts, though most of them are broken off, are slenderer than the proximal parts and are covered with distinct spines. These spines are directed obliquely near the distal end of the spicule and gradually come to project perpendicularly to the shaft, near the base of the protruded parts of the same spicule. The proximal third, which is imbedded in the body of the sponge, has quite a smooth surface. The distal end is probably somewhat inflated, beset laterally with a pair of pointed spines, since such cuspidates usually occur in members of this genus. The proximal end is simply sharply pointed.

The supporting spicules of the interior are exclusively stout oxypentactins. Their four paratangential rays are somewhat shorter

than the proximal unpaired ray, which measures 3 mm to 5 mm in length. Their rays are quite smooth and taper gradually toward the conically pointed end, measuring 30μ to 50μ thick at the base.

In the parenchymalia and hypodermalia, there are greater or smaller numbers of macrouncinates, 6μ to 7 mm or more long and up to 10μ thick. They are quite similar to the macrouncinates occurring in species of *Farrea* and are covered with spines situated very obliquely and extending nearly parallel, close to the shaft of the spicule. They are arranged radially or irregularly, the thicker distal end lying in the outer surface of the sponge. Frequently the macrouncinates show a heteropole form, having a sharply pointed distal end and a spherically expanded proximal end whose surface is nearly smooth or slightly rough. The entire surface of the spicule, except the proximal end, is also covered with obliquely directed spines.

I will not describe the microscleres. Pinules are found in the dermal membranes, where they generally stand close together, forming a quadratic network because the basal rays extend side by side for considerable lengths, while in the gastral membrane they are sparsely distributed, not forming a network.

The dermal pinules are somewhat smaller than the gastral ones. They are about 160μ to 230μ high; their basal rays, which form a rectangular cross, are about 180μ to 240μ long, gradually attenuated toward the conically pointed end, and slightly spined on all parts, most distinctly so on the distal part. The unpaired distal rays have a prominent terminal spine and numerous long and somewhat stout lateral spines, terminally only slightly curved, extending obliquely upward. It consists of a smooth proximal part 8μ to 12μ thick and 12μ or more long, and a somewhat bushy, conically shaped distal part 28μ in breadth, covered with obliquely curved spines proximal to it, with vertically directed spines.

The gastral pinules have a considerably longer distal unpaired ray measuring 300μ to 360μ in length, with the basal rays 210μ to 230μ long, but otherwise nearly similar to the dermal pinules. In these pinules, the distal ray shows a somewhat whiplike appearance, covered with tolerably short spines, obliquely directed upward.

I have not been able to find any macramphidisks. I do not wish to assert, however, that such spicules are entirely absent. Mesamphidisks are very sparsely scattered in the parenchymalia. They measure about 125μ in length and have bell-shaped terminal disks 25μ high and 36μ broad, with 8 to 12 marginal teeth, pointed at the ends. Micramphidisks are of the usual shape, with hemispherical terminal disks 10μ broad and 12 to 18 marginal teeth. They measure about 28μ in length.

Microhexactins are numerous in the parenchyme of the entire sponge body. Their rays are frequently of a medium thickness of 6μ

and sometimes much slenderer, and are covered with numerous microspines irregularly distributed on the surface.

The microuncinates, which are nearly similar to those occurring in *Sericolophus reflexus* Ijima, are fairly abundant, are 4μ broad at the center, and are spindle-shaped, with both ends sharply pointed and the surface quite smooth.

Genus SERICOLOPHUS Ijima, 1901

SERICOLOPHUS REFLEXUS (Ijima)

Hyalonema reflexum IJIMA, Zool. Anz., vol. 17, p. 336, 1894.
Sericolophus reflexus IJIMA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 15, p. 128, 1901; *Siboga*-Expeditie, vol. 6, pp. 26–28, 1927.

There are 13 specimens of *S. reflexus* in the collection. The difference between the dermal and gastral pinules is not only in the state of the spines on the distal ray, as described by Ijima from the specimens from Sagami Sea, but also from my observation it is found in the dimensions of corresponding parts of the spicules. The distal ray of the gastral pinule averages 160μ to 260μ in length, 14μ broad at its base, and the basal crossing rays attain a length of 240μ and are 8μ broad at the base. The dermal pinules, though somewhat smaller than those of the type specimen, have a distal ray 120μ to 160μ in length and basal rays 70μ to 100μ long. The hexactinic dermal pinules are infrequently found in the ectosome of several specimens. The paratangential ray is 70μ to 90μ long and terminally pointed. The proximal ray is 90μ long and the distal pinular ray 136μ long.

The parenchymal microxyhexactins are much slenderer and their prickles are not so prominently developed as those of *Siboga* specimens of this species. From my observations of the preparations of the *Siboga* specimens and those from the Sagami Sea it is evidently exhibited that the parenchymal oxyhexactins may vary considerably in size and shape. The *Siboga* specimens have more robust and larger rays, beset with prominent prickles on the surface, while the present specimens have distinctly slenderer rays and very slightly developed prickles. The Sagami Sea specimens have the spicules intermediate in size.

Besides the microxyhexacts, which occur abundantly in the type specimen as well as in the present ones, there exist other micropentacts, which are mostly distributed in the wall of the excurrent canals and in the parenchyme, intermixed with the microxyhexacts. The spicule is provided with an unpaired distal ray 100μ to 180μ long and with a paratangential basal ray 190μ to 320μ long, the surface of which is slightly roughened. Frequently the basal rays are curved to certain directions near the distal ends.

An uncinate with one end thickened, 12μ in breadth, the other sharply pointed and with a wholly echinated surface, is frequently present in the dermal membrane. It measures 200μ to 310μ long and 6μ broad at the center.

A monact measuring 300μ in length and 25μ in breadth at the center, with conical ends, occurs infrequently in the parenchyma. This spicule somewhat resembles the microuncinate described by Ijima in Japanese specimens, though it has much larger dimensions in length and breadth; but it seems to me to show in shape and constitution some similarity to the microuncinate.

TABLE 4.—*Measurements of 13 specimens of* Sericolophus reflexus

Specimen	Collected at—	Body		Breadth of reflected portion	Root-tuft		Breadth of basal portion	Size of exhalent aperture
		Length	Breadth		Length	Thickness		
		Mm	*Mm*	*Mm*	*Mm*	*Mm*	*Mm*	*Mm*
A	Station 4917, off Kagoshima Gulf, 361 fathoms.	33	15	3.2	31	2	4	1
B	Station 4919, off Kagoshima Gulf, 440 fathoms.	37	28	6	70	2	3	1×2
C	do	41	26	9	60?	2	5	1
D	do	64	37	18	90	4	9	2–2.5
E	do	75	46?	16	97	5	8.5	1.5–3
F	do	110	------	25	140	8	------	--------
G	do	80	40	20	------	------	------	1×3–2.5
H [1]	do	80?	45?	19?	------	------	------	1–2.5
I	Station 4920, off Kagoshima Gulf	103?	53	25	------	------	------	3–2
J	do	115	57	33	------	------	------	3×5.5–4
K	do	105	55	28	------	------	------	3×4–3
L	do	------	74	40	------	------	------	3×5.5 2×3
M	Station 5083, off Onmaizaki, Suruga Bay	21	8	3	30	1	1.5	1–1.8

[1] Two other fragments not measured.

Genus SEMPERELLA J. E. Gray, 1868

SEMPERELLA SCHULZEI Semper

Semperella schulzei SEMPER, Verh. phys. med. Ges. Würzburg, vol. 1, p. 272, 1868.—MARSHALL, Zeit. Wiss. Zool., vol. 25, suppl., p. 212, pl. 12, fig. E, 16, 17, 1875.—MARSHALL and MEYER, Mitth. Zool. Mus. Dresden, vol. 2, p. 276, pls. 14, 15, figs. 18, 19, 1877.—F. E. SCHULZE, Abh. kön. preuss. Akad. Wiss. Berlin, 1886, p. 67; Rep. Voy. *Challenger*, vol. 21, p. 261, pls. 51, 52, 1887.—BLACKBURN, Trans. Manchester Micr. Soc., 1896, pp. 57–61, pl. 1.

I have examined eight specimens of this species (Table 5). The three complete and the two fragmental specimens exhibit nearly the same outer configuration, but specimen H shows a somewhat different outer appearance and mode of spiculation.

Specimen A is a complete, medium-sized, and well-preserved specimen, 71 mm high, and, exclusive of the basal tuft, 25 mm long. The broadest part of the body measures 16 mm. The distinct, beveled longitudinal edges, which form a regular hexagonal-shaped sponge body, are four in number. Specimen B shows a nearly complete body and appears to be the youngest specimen of all. It was superficially injured and considerably macerated on the dermal network, only the parenchymal supporting-skeleton and here and there small parts of the dermal membrane being preserved. Specimen C is a fragment of the superior regions of the sponge body.

TABLE 5.—*Measurements of 8 specimens of* Semperella schulzei

Specimen	Collected at—	Description	Lateral pentact pinules	Basal rays of lateral pentact pinules	Pinules on ridges		Macramphidisk	Mesamphidisk	Micramphidisk
					Distal ray	Basal rays			
			μ	μ	μ	μ	μ	μ	μ
A	Station 4900, 10 to 20 miles SW. of Gotô Islands, 139 fathoms.	Small, complete	90-120	72-90	280	72-80	220	80-110	20
B	do	do	80-140	70-80	?	?	180	100	20
C	do	Large fragments of superior parts of sponge body.	80-120	70-100	?	?	180-220	80	20
D	Station 4903, 10 to 20 miles SW. of Gotô Islands, 139 fathoms.	Complete	90-120	65-100	240-360	70-80	230	90	20
E	do	Small fragment	90-120	70-100	240-300	70-80	230-320	70-85	20
F	Station 4934, off Kagoshima Gulf, 103 fathoms.	Large fragment of superior regions.	80-100	90-100	240-360	70-80	210-340	80-108	20
G	do	do	90-120	70-105	230-300	70-80	230-300	80-110	20
H	do	do	90-120	104	240-360	70-85	240-280	90-100	16-20

A beautiful specimen (D), 109 mm in length and 11 mm to 27 mm in thickness, was taken near the Gotô Islands at Station 4903. Another (E) has been well preserved and remains almost uninjured. The club-shaped body measures 74 mm in length, exclusive of the basal tuft. Inferiorly it has a cylindrical form, gradually widening upward and forming an irregular pentagonal prism with conically pointed ends. At its broadest part the body measures 27 mm and the lateral wall between the two projecting longitudinal ridges 10 to 12 mm. These ridges somewhat anastomose by means of cross processes.

Specimens F and G are two similarly shaped large fragments of the superior regions of the sponge body but of much larger specimens. Their breadth is 35 mm to 39 mm at the broadest part. Among the other specimens from Station 4934 there was a much larger fragment (H), which agrees in many points with the present

species, though it has a somewhat different appearance. It has a cucumber-shaped body, slightly curved at the middle, and beset with a slightly irregular truncate tip. In these points it somewhat resembles *Semperella cucumis* Schulze. There are indeed some differences as above mentioned, but these may be explained as individual variations. The specimen has a total length of 167 mm. The basal regions are much injured and have fallen off.

In the specimens of this species hitherto known the diactinic marginalia, which project from near the peak of the sponge body, are not present, while in the present specimens (except H) they always show a distinct, short, brushlike appearance. These diacts are arranged nearly in one series, projecting from the elevated ridges near the conically pointed tip of the sponge body. They measure 10 mm to 20 mm in length, projecting from the surface of the ridge about half or more of the entire length, and 8 mm to 12 mm in breadth at the center. Frequently among these diacts, there occur spicules beset with prickles, bent very slightly obliquely upward and outward, and disposed in two opposite rows along the distal part of the external portion. This spicule slightly resembles that represented in the younger specimen of the *Challenger* collection but it is doubtful whether it represents the remains of those projecting from the top of the beveled longitudinal edges or whether it belongs entirely to a different category.

In the large specimens from Station 4934 I find a larger isolated form of amphidisks about 280μ long, provided with 8 to 12 paddle-like and terminally slightly pointed or only rounded rays. Besides these, though nearly absent or very rarely present in the smaller specimens (A to E), I find a sparsely distributed, similar form of medium-sized amphidisks present in the larger specimens (F to H). The slender middle-sized amphidisk occurring in the *Challenger* specimens may be lacking in all the specimens of this species in the collection.

Among the ectodermal pentact pinules, there occur also fairly abundant pinules that have big, long, straight paratangentials, measuring 12μ broad and 105μ long and beset with prominent hooklike lateral spines.

The heteropole uncinate, which is nearly allied to the uncinatum-like oxydiact in the *Challenger* specimen of this species, occurs rarely in the hypoderm of specimen H.

The anchorlike spicule of the basal tuft frequently forms a strongly developed trifurcate anchor at its lower end, measuring 140μ in width. This spicule in large bundles is intermixed with the ordinary basal spicule, which ends in an anchorlike structure, beset with two long recurved opposite teeth in the same plane. The shaft is biseriate with alternately disposed barbules.

Family HYALONEMATIDAE J. E. Gray, 1857

Genus HYALONEMA J. E. Gray, 1832

HYALONEMA (CYLICONEMA) APERTUM F. E. Schulze

Stylocalyx apertus F. E. SCHULZE, Abh. kön. preuss. Akad. Wiss. Berlin, 1886, p. 59.

Hyalonema (*Stylocalyx*) *apertum* F. E. SCHULZE, Rep. Voy. *Challenger*, vol. 21, p. 214, pls. 37, 38, 1887; Abh. kön. preuss. Akad. Wiss. Berlin, 1894, p. 39, pl. 8, figs. 1–6.

Hyalonema affine MARSHALL, Zeit. Wiss. Zool., vol. 25, suppl., p. 225, 1875.

Hyalonema affine japonicum F. E. SCHULZE, Sitz-ber. Ges. Naturf. Freunde Berlin, 1899, pp. 112–129.

Hyalonema affine reticulum F. E. SCHULZE, Sitz-ber. Ges. Naturf. Freunde Berlin, 1899, pp. 112–129.

Hyalonema maehrenthelli F. E. SCHULZE, Abh. kön. preuss. Akad. Wiss. Berlin, 1894, p. 41, pl. 8, figs. 7–11.

From a depth of 472 fathoms in the vicinity of Koshiki Island, four specimens of *Cyliconema* were dredged (Table 6). In all the body is still well preserved, though the basal tuft remains in only two. Specimens A to C show the cup-shaped sponge body, which is characteristic of this species in Japan, while specimen D exhibits a somewhat different outer configuration forming a transversely extended thick-walled calyx, the lower end of which is somewhat torn off but otherwise well preserved. The superior terminal surface is nearly flat, somewhat fallen in at the center, and forms a horizontally extending rim 50 mm broad, providing a sharp-angled projecting marginal fringe, which thins out toward the margin and flares outward and backward. From the central sunken portion, a markedly pointed and fairly long cone projects. An irregularly formed large pore (incurrent canalar aperture) opens widely on one side of the cone at its base, while near the base several fairly large and nearly circular pores (incurrent canalar apertures) open. The whole lateral surface shows distinctly, even to the naked eye, the rectangular latticework of the dermal membrane.

TABLE 6.—*Measurements of 4 specimens of* Hyalonema (Cyliconema) apertum

Specimen	Collected at—	Description	Dermalia	Gastralia	Microhexactin		Macramphidisk	Mesamphidisk	Micramphidisk
					Curved rays	Straight rays			
			μ	μ	μ	μ	μ	μ	μ
A	Station 4915, Koshiki Island, 472 fathoms	Complete	200–250	70–140	60–80	60–70	180–260	40–100	16–20
B	do	do	210–280	100–160	70–90	40–80	160–205	40–60	16–24
C	do	do	340–400	100–140	70–80	50–75	230–340	60–80	16–20
D	do	do	180–250	120–160	80–100	60	180–360	60–100	12–16

It is doubtful whether a specimen (E) from Bungo Channel here assigned to *H.* (*Cyliconema*) *apertum* really represents this species or another. I consider it better for the present to place it with *H.*

(*Cyliconema*) *apertum* than to make it a new species, even though it is distinguished from the type of the species by the quite different outer configuration.

It is tulip-shaped, abruptly truncated terminally, 4 cm long, and 2.7 cm broad above. The gastral area is flatly exposed without being depressed, entirely lacking the central cone, which is usually present in the typical specimens, and somewhat flared out upward and outward as a free edge. The excurrent apertures open externally directly on the gastral area and are fairly numerous and somewhat circular, and 1 mm to 4 mm in diameter. The dermal, lateral, and gastral surfaces appear quite smooth and even.

In this form the macramphidisks appear to be of two kinds. One is common on the dermal membrane, measuring 220μ to 312μ in length and 108μ to 116μ broad at the semicircular terminal disk, which may be quite similarly shaped to that of *H.* (*Cyliconema*) *apertum solidum;* while the other, in the parenchyma, usually exhibits a smaller size, 140μ in length, with the shaft only particularly tuberculous in its central part, not over the entire part as in the dermal larger macramphidisk.

Acanthophores of this specimen consist of fairly large stauractins, which exhibit a nearly straight and quite smooth surface except on the terminal ends, the surfaces of which are roughened and somewhat inflated.

Table 7 may serve to show the relative proportions of various spicules represented by specimens A to D from Koshiki Island, and specimen E from Bungo Channel.

TABLE 7.—*Comparison of specimens of* Hyalonema (Cyliconema) apertum *from Koshiki Island and Bungo Channel*

Specimen	Collected at—	Dermal pinule	Amphidisks		
			Macra-	Mesa-	Micra-
		μ	μ	μ	μ
A, B, C, D	Station 4915, Koshiki Island, 472 fathoms	200–250	160–360	40–100	12 24
E	Station 4959, entrance to Bungo Channel, 405 fathoms.	200–240	a—220–312 b—140	60–80	20–30

Specimen	Collected at—	Microxyhexact		Tignule	Gastral surface	Central core on gastral surface
		Curved rays	Straight rays			
		μ	μ			
A, B, C, D	Station 4915, Koshiki Island, 472 fathoms.	60–100	40–80	3 mm–4 mm by 200μ.	Depressed	Present.
E	Station 4959, entrance to Bungo Channel, 405 fathoms.	85–100	80	4 mm–5 mm by 160μ.	Flat	Absent.

HYALONEMA (CYLICONEMA) APERTUM SOLIDUM, new subspecies

PLATE 1, FIGURES 1, 2

In the collection are three specimens representing a new form. They were found at three stations not far apart.

TABLE 8.—*Measurements of 3 specimens of* Hyalonema (Cyliconema) apertum solidum

Specimen	Collected at—	Description	Dermalia	Gastralia	Microhexactin	
					Curved rays	Straight rays
			μ	μ	μ	μ
A	Station 4957, Bungo channel, 437 fathoms.	Complete, cuplike	80–140	60–150	50–70	40–45
B	Station 4919, about 90 miles WSW. of Kagoshima Gulf.	do	80–180	80–120	60–80	45–55
C	Station 4959, Bungo Channel, 405 fathoms.	Complete, dishlike	90–120	80–120	60–70	45–65

Specimen	Collected at—	Macramphidisk	Mesamphidisk	Micramphidisk
		μ		μ
A	Station 4957, Bungo channel, 437 fathoms.	145–210	Very rare, 30μ–45μ	18–20
B	Station 4919, about 90 miles WSW. of Kagoshima Gulf.	160–245	Probably wanting.	20–26
C	Station 4959, Bungo Channel, 405 fathoms.	140–200	Very rare, 36μ–40μ	16–28

Specimens A (holotype, U.S.N.M. No. 22054) and B are tulip-shaped and have a deeply concave gastral cavity, the surface of which is perforated with few excurrent apertures; while specimen C shows an entirely different outer configuration, forming a shallow transversely expanded body like the fruit of a lotus. The gastral surface is nearly flat, showing the irregular lozenge form with a thin-edged outer margin.

The difference between the external appearances of these specimens originally induced me to contemplate the establishment of two distinct species, but microscopic observation shows agreement in their spiculation to such an extent that I have decided to consider all one form.

One of the chief characters separating *H.* (*Cyliconema*) *apertum solidum* from *apertum* proper is to be found in the shape of the macramphidisk, which presents a constant form as follows: The terminal disk of this amphidisk is somewhat semicircular, contracting inward on either side at the base, and curved inward at the ends, with the proportion of the breadth and the height in the marginal teeth nearly always 1:1.5.

The microxyhexactins of this subspecies have a much more robust appearance than those of the typical form but are otherwise very similar.

Another difference between this and the typical form is in the length of the distal ray in the dermal pinules. In the present subspecies it averages 100μ to 150μ in length, while that of the typical form is usually 200μ to 250μ.

HYALONEMA (CYLICONEMA) HOZAWAI, new species

FIGURE 2; PLATE 1, FIGURES 3, 5

The two specimens (Table 9) for which I establish this species are entirely different in shape and of totally different size. The extreme differences between the two specimens originally led me to consider the establishment of two distinct species, but microscopic examination shows them to agree in the spiculation to such an extent that I have concluded to place both in one species.

Specimen A is tulip-shaped, abruptly truncated terminally, 85 mm long and 62 mm broad above, 30 mm broad below. The oscular sieve plate is nearly circular, deeply concave, and raised toward the margin. The pores of the sieve plate are tolerably numerous, more or less circular, and vary in size from 3 mm to 5 mm. The sponge body in alcohol is light grayish.

Specimen B (holotype, U.S.N.M. No. 22030) has a spindlelike form. The upper end is not transversely truncated, but extends to a somewhat pointed apex, in the form of a projecting fez, 35 mm in height, which part may constitute the gastral surface, being directed straight forward. The conelike gastral surface is even and smooth, the excurrent canalar apertures being concealed by the thickened gastral membrane. The basal tuft, except for an encrustation near the lower end, is free of *Palythoa*. It measures 70 cm in length.

TABLE 9.—*Record of specimens of* Hyalonema (Cyliconema) hozawai

Specimen	Collected at—	Description
A	Station 4956, off entrance of Bungo Channel, 720 fathoms	Complete, large.
B	do	Complete, small.

Spiculation.—The most numerous parenchymal macroscleres are oxydiactins. Those of the common type are very slender and smooth over the entire surface, and make up a small, strongly curved strand. They vary from 1 mm to 2 mm in length and from 12μ to 16μ thick at the center. The other type, sparsely scattered in the ectosome and in the choanosome, is also smooth over the entire surface and straight.

It frequently has a clearly defined central inflation, which usually bears two knobs arranged on each side. The size of the oxydiactin is fairly variable, generally 0.5 mm to 1.5 mm long and 20μ to 25μ thick.

Oxyhexactins occur much less frequently. Their rays are nearly the same length, smooth, 30μ thick, and gradually attenuated toward

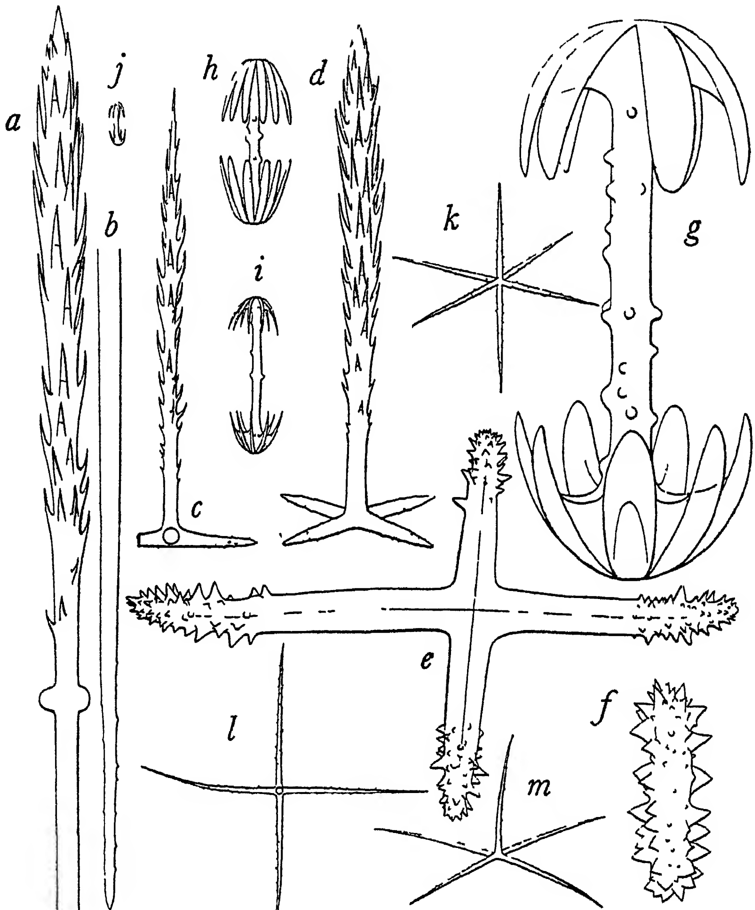


FIGURE 2.—*Hyalonema* (*Cyliconema*) *hozawai*, new species: *a*, Distal part of diactinic marginalia; *b*, proximal part of diactinic marginalia; *c*, dermal pinule; *d*, gastral pinule; *e*, acanthophore; *f*, acanthophore; *g*, macramphidisk; *h*, mesamphidisk; *i*, young macramphidisk in basal regions; *j*, micramphidisk; *k*, microxyhexactin; *l*, microstauractin; *m*, micropentactin. All × 250

the pointed end. The paratangential rays are sometimes curved, measuring 50μ to 600μ long. The distal ray is 510μ long and the proximal ray 680μ, and usually straight.

In the subdermal oxypentactins, which form an important part of the supporting skeleton, the paratangential basal rays are con-

siderably shorter than the radial ray, which measures 0.4 mm to 0.7 mm or more in length. All the rays are smooth over the entire surface and attenuated gradually toward the pointed ends.

In both specimens the acanthophores (fig. 2, *e*, *f*) near the lower end of the body are clearly chiefly composed of cross-shaped tetractins and large straight diactins. In specimen A, the diactinic acanthophores are most numerous, with a few tetractinic ones mixed in; while in specimen B, the latter are the more numerous. All the superficial diactinic acanthophores are covered with uniformly developed, robust, short spines and have the appearance of being covered with crystallized sugar. The basal parts of the tetractinic acanthophore are mostly smooth, frequently straight, and bear spines on the somewhat inflated, terminal parts of the rays only.

The diactinic marginalia (fig. 2, *a*, *b*) forming the fringe of the oscular margin and the margin of pores on the sieve plate are not more than 600μ to 850μ long. The proximal ray of these spicules, which is imbedded in the body of the sponge, is perfectly smooth; the distal free ray, resembling a Lombardy poplar in shape, measures 30μ to 40μ broad, is covered with oblique spines, and has a distinct distal spine. The center of the spicule bears four rounded protuberances arranged crosswise and containing rudiments of axial canals.

The dermal oxypentactinic pinules (fig. 2, *c*) sparsely cover the strands of the external network. Their four basal rays, which form a rectangular cross, are 10μ in thickness, 35μ to 50μ long, terminally pointed and finely granular. Their free radial ray varies from 240μ to 280μ in length, is smooth on the proximal third, uniformly attenuated toward the sharp-pointed end, and covered with obliquely directed spines on the distal two-thirds. The spines attain the greatest length near the lower end of the distal spined part of the ray; upward they gradually decrease in size.

The canalar pinules are nearly similar, a little shorter, not more than 200μ long, and slenderer and covered with fewer spines. They occupy the walls of the larger incurrent canals but do not stand nearly so close together as the dermal pinules on the external surface.

The pinules of the oscular sieve plate are a little shorter in the distal radial ray, measuring 200μ long and 20μ to 30μ broad; they also resemble a Lombardy poplar. The basal cross measures 80μ to 110μ in length and is finely roughened by the presence of microspines. These spicules are distributed much more closely together.

The dermal macramphidisks (fig. 2, *g*) vary in length from 200μ to 320μ. The shaft is 2μ to 20μ broad and usually bears rounded

tubercles sparsely and irregularly scattered over the surface. The rather flat terminal disks are 70μ to 125μ high, 104μ to 120μ broad, on an average, and have eight broad, spadelike marginal teeth. These amphidisks are scattered sparsely in the derm over the superior regions of specimen A, while on the inferior regions and on all parts of specimen B they are found abundantly.

Ellipsoidal mesamphidisks (fig. 2, *h*) of varying size, 60μ to 80μ long on an average, are abundant. The shaft is slender, 4μ broad, and covered with numerous sharp spines. The high, bell-shaped terminal disks, 24μ in breadth, usually have 10 to 12 narrow marginal teeth. On the basal regions of both specimens A and B there exist much larger mesamphidisks, which measure 100μ to 145μ in length. These have also 10 to 12 marginal teeth, 48μ in length at the bell-shaped terminal disk, which measures 40μ broad.

The micramphidisks (fig. 2, *j*) are most numerous and lie scattered irregularly in the dermal and gastral membrane. In fewer numbers they are found in the parenchyme. They are 16μ to 20μ long and have hemispherical terminal disks with numerous marginal teeth.

Microxyhexactins (fig. 2, *k*) are abundant in the parenchyme. Their rays are 60μ to 80μ long, 4μ thick at the base, straight, and covered throughout with small tubercles, making the surface appear rough. The curved, rayed microxyhexactins are totally absent. Occasionally similar-sized pentactins (fig. 2, *m*) and stauractins (fig. 2, *l*) are found. In the pentactins the distal unpaired ray is much shorter than the paratangential rays, measuring 40μ long.

The present new species somewhat resembles *H. indicum andamanense* F. E. Schulze, but differs from it by having differently shaped gastral pinules and the poplar-tree-shaped diactinic marginalia.

HYALONEMA (COSCINONEMA) KIRKPATRICKI GLOBOSUM, new subspecies

PLATE 2, FIGURE 3

Stations 4956 and 4957, where the two specimens of this subspecies were captured, are not far apart. The best preserved specimen (designated holotype, U.S.N.M. No. 22031) has a nearly truncated cone and is 135 mm long. Its root tuft, however, has been entirely torn off. The broader upper end has a diameter of 85 mm. The lateral dermal surface of the sponge body is more or less crushed and injured, but in most of it the quadrate dermal latticework is well preserved. The sieve plate is deeply depressed in the center and raised toward the margin to form a low ring wall with a somewhat sharp edge. The surface is perforated by more or less circular, irregularly scattered apertures, 1 mm to 4 mm wide. The

openings of the other specimen, evidently a large fragment of the superior regions of the sponge body consisting of a strongly compressed lamella, are poorly preserved. (Table 10.)

TABLE 10.—*Record of specimens of* Hyalonema (Coscinonema) kirkpatricki globosum

Specimen	Collected at—	Description
A	Station 4956, off entrance of Bungo Channel, 720 fathoms	Large, complete.
B	Station 4957, off entrance of Bungo Channel, 437 fathoms	Large fragment.

The chief differences between the typical form and the new subspecies are in the type of macramphidisk and in the much longer dermal pinules. In the present form, the macramphidisk seems somewhat smaller, measuring 200μ to 260μ long, and bearing on its shaft numerous tubercles, not only on the shaft center, as in the typical form, but also on the entire surface. In this spicule, the comparative dimensions of the length and breadth of the terminal disks and the entire length of the spicule are somewhat different from those of the typical form. This fact may account for the complete dissimilitude of the configuration of the two.

The distal ray of the pinules, varying from 180μ to 560μ in length, is longer than in typical *kirkpatricki*.

Because of these differences, I consider the present specimens as representing a distinct form of *H.* (*Coscinonema*) *kirkpatricki* Ijima.

HYALONEMA (COSCINONEMA) OVATUM, new species

FIGURE 3; PLATE 2, FIGURE 2

The fairly large and completely preserved specimen of this new species (holotype, U.S.N.M. No. 22032) was taken from a depth of 918 fathoms, SSW. of Omaizaki (Station 5084). The body of the sponge is oval, 86 mm long, 45 mm broad, and dorsoventrally or posteroanteriorly slightly compressed. It is difficult to say whether this compression and rugosity were present in the living sponge or whether they were produced post mortem by pressure. The anterior oscular depression is very narrow and shallow, measuring about 30 mm in width. The root tuft where it arises from the lower end of the sponge body has entirely fallen off, but the point of attachment is indicated by the destruction of the dermal membrane. Through the compact and somewhat transparent quadratic dermal reticulation of the outer surface one can not see the subdermal cavities and the openings of the incurrent canals.

Spiculation.—The important macrosclere parenchymalia are the oxydiactins. These are mostly isolated, more rarely aggregated in bundles, and appear abundantly throughout the interior. They are

slender, straight, or sometimes slightly curved, and 1.7 mm to 2.5 mm or more long, terminating with a somewhat expanded roughened point at either end. Beside these, are frequently found the shorter oxydiactins, quite smooth on the surface, with two or four central well-defined protuberances in the middle, and measuring 1.2 mm to 2 mm in length and 20μ broad at the center.

Between these spicules, sparsely scattered smooth oxyhexactins of varying size, 1 mm to 1.2 mm in axial length, are found. The para-

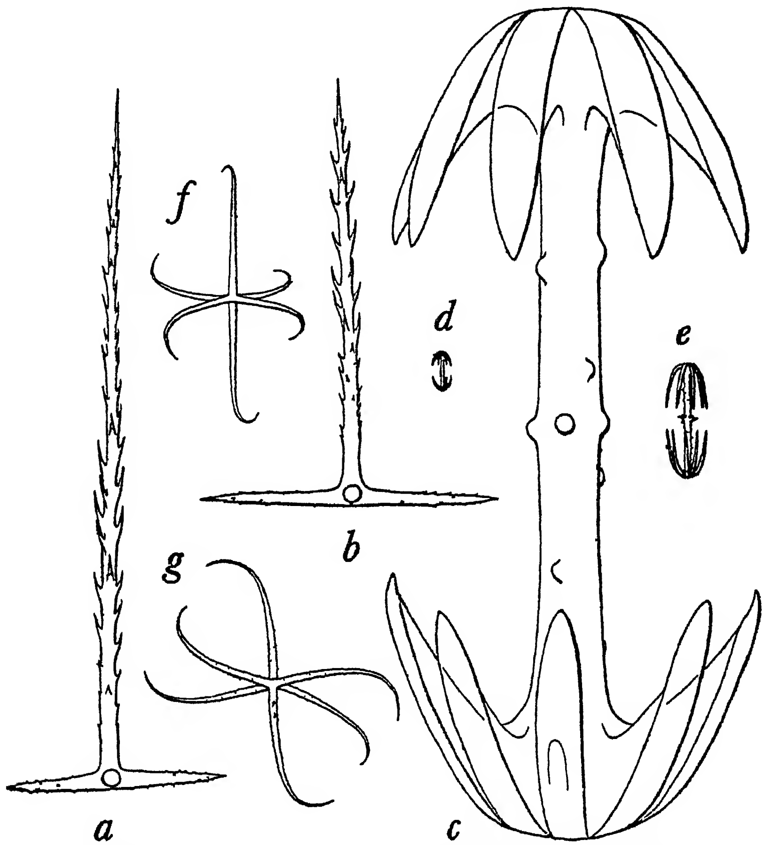


FIGURE 3.—*Hyalonema (Coscinonema) ovatum*, new species *a*, Dermal pinule; *b*, canalar pinule; *c*, macramphidisk; *d*, micramphidisk; *e*, mesamphidisk; *f*, oxyhexactin; *g*, oxyhexactin. All × 300.

tangential and distal rays are usually shorter than the proximal ray, and all the rays measure 28μ broad at the base, being gradually attenuated toward the pointed ends.

The oxypentactins appear as regularly arranged hypodermalia, lying below the outer surface and supporting the dermal membrane. Under the gastral membrane there are probably no such spicules. In these spicules the paratangential rays are mostly shorter than the proximal unpaired ray, measuring 200μ to 850μ in length, while the

breadth at the base is nearly the same in all, 20μ to 40μ. All the rays are smooth on the surface and gradually attenuated toward the conically pointed end.

Of the microsclere parenchymalia I shall first describe the oxyhexactins (fig. 3, *f*, *g*). These occur abundantly in varying numbers in different regions of the sponge and measure 120μ to 150μ in diameter. Their rays are fairly stout, quite smooth, sharply pointed, and extremely curved at the end. Of the curved tangential rays, I have found two kinds: Some are curved away from their fellow at the end, while others are directed toward one another on one side. I have found the former condition much commoner than the latter. In the subdermal regions, these oxyhexactins are frequently arranged in lines and groups of several. Other than in these regions, I found these spicules also in the subgastral region and in the parenchyme, as well as in the wall of the excurrent canals, where they were distributed both in groups and separately. Besides these oxyhexactins, oxypentactins of the same features are found infrequently intermixing with the former.

Oxypentactinic dermal pinules (fig. 3, *a*) cover the external surface in great numbers. Their four basal rays, which form a rectangular cross, are of medium thickness and measure 6μ at the base and 45μ in length; terminally they are pointed and irregularly roughened. The free radial ray is on the average 200μ long, smooth in the proximal third, uniformly attenuated toward the pointed end, and in the distal two-thirds irregularly covered with rather short, slightly divergent spines. The spines attain their greatest length at the middle or somewhat below the distal spined parts of the ray; above and below they gradually decrease in size.

The canalar pinules (fig. 3, *b*) are nearly similar; the distal ray being a little shorter than that of the dermal pinules, instead of having a longer paratangential ray, measuring 60μ in length. They occupy the walls of the larger incurrent canals but do not stand nearly so close together as the dermal pinules on the external surface.

The gastral pinules (fig. 3, *a*) are entirely similar to those of the derm.

Macramphidisks (fig. 3, *c*) are found infrequently on the dermal membrane itself and are entirely absent in the hypodermalia and in the internal parenchyme. They attain a considerable size, 350μ or more in length. The shaft is either smooth or covered with a few irregularly distributed small tubercles, and measures 30μ in width at the center. The terminal disks are 100μ long and 160μ broad, nearly semicircular, and somewhat expanded proximally and narrowed distally at the flattened ends. They have 8 to 9 marginal teeth, 100μ long, which terminate with somewhat lancet-shaped points.

Mesamphidisks (fig. 3, *e*), which vary in size considerably and measure 30μ to 90μ long, occur chiefly on the walls of larger excurrent canals as a layer and are scattered in the parenchymalia. The narrower incurrent canals are destitute of such a layer or coating of mesamphidisks, being instead occupied by pentactinic pinules. The shaft is slender and covered with sharp spines. In the center there is a ring of longer spines. The high, bell-shaped terminal disks have 10 to 12 marginal teeth, usually narrow, measuring 20μ to 30μ in length and 20μ to 25μ broad.

Micramphidisks (fig. 3, *d*), which are much fewer than the former, lie scattered irregularly in the dermal and gastral membrane; still fewer are found in the choanosome. They are 15μ to 20μ long and have hemispherical terminal disks with several marginal teeth.

Although I find the outer features of this sponge peculiar, the facts stated above enable me to place it systematically. At first doubting whether it should be placed in the present genus or in some other genus of the Hyalonematidae, or whether a new genus should be established for it, I have come to the conclusion that the entire spiculation, particularly the dermal pinules and the parenchymal oxyhexactins with their curved rays, is in complete accordance with what I find in the other representatives of *Hyalonema.*

HYALONEMA (CORYNONEMA) OWSTONI Ijima

Hyalonema owstoni IJIMA, Zool. Anz , no. 459, p. 367, 1894.
Hyalonema clathratum IJIMA, Zool. Anz., no. 459, p. 368, 1894.

In the collection I discovered a complete specimen and two fragments referable to the present species, obtained from Station 4958. The first, specimen A, represents a complete, tolerably large, slightly inflated cup. It is 46 mm high and has, at the upper free margin of the cup, where broadest, a transverse diameter of 55 mm. The outer dermal surface is composed of a fine and nearly uniform smooth and even network. The inner surface is perforated by numerous more or less circular apertures, 1 mm to 6 mm wide, which are the openings of the excurrent canals into the cup cavity, which is the gastral cavity of the sponge. These canal mouths are irregularly distributed and decrease in size toward the upper, free margin of the funnel wall. There is no trace of an oscular sieve plate.

TABLE 11.—*Record of specimens of* Hyalonema (Corynonema) owstoni

Specimen	Collected at—	Description
A	Station 4958, off entrance of Bungo Channel, 405 fathoms	Complete.
B	do	Large fragment.
C	Station 4976, SW of Shiomisaki in Kii, 545 fathoms	Do.

The second specimen (B) is a fragment of large sponge body, having small parts of perforated gastral wall.

Another tolerably large fragment (C), which I am inclined to refer to the same species, has come under my observation. It was obtained from Station 4976 (southwest of Shiomisaki, Kii). It is a portion representing the greater part of the upper section of an individual probably similarly shaped, but somewhat smaller than the second specimen. The gastral cavity of the sponge has also, here and there, large openings of the excurrent canals, measuring 3 mm to 7 mm in diameter.

The outer dermal surface seems much macerated and its membrane probably has fallen off.

In the first and second specimens the barrel-shaped mesamphidisks are much more numerous than another kind that are present abundantly in the third specimen, in which the barrel-shaped ones are also sparingly represented.

The essential difference between *H.* (*C.*) *owstoni* and *H.* (*C.*) *clathratum* is the presence of the barrel-shaped mesamphidisk, but from the observation of the three specimens in question, such a specific difference is perhaps unsatisfactory. Though *owstoni* may not prove specifically separable from *clathratum*, it has a different gastral aspect. I have also found much larger dermal pentactinic pinules, which attain a length of 280μ and a breadth of 68μ in the distal ray.

INDETERMINABLE HYALONEMATIDS

The collection includes several fragmentary macerated specimens that are probably referable to *Hyalonema*, but that can not be more definitely identified on account of their incomplete state:

Station 4911 (10 to 20 miles southwest of Koshiki Islands); a macerated specimen with a very long, beautiful root tuft.

Station 5069 (entrance to Enoura, Suruga Gulf); macerated fragments.

Suborder HEXASTEROPHORA F. E. Schulze, 1899

Tribe HEXACTINOSA Schrammen, 1910–12

Subtribe CLAVULARIA F. E. Schulze, 1886

Family FARREIDAE F. E. Schulze, 1886

Genus FARREA Bowerbank, 1862

FARREA KURILENSIS, new species

FIGURE 4; PLATE 3, FIGURE 2

This new species is represented by a large colony (holotype, U.S.N.M. No. 22034) attached to a plate of large cirripeds. It was

obtained from a depth of 229 fathoms, southeast of Shimushir Island, Kuriles, at Station 4804. The irregular, largely expanded colony attains a height of 18 mm; its greatest width is about 75 mm. Unfortunately the outermost ends of the tubes are broken off for a greater or lesser distance. The diameter of imperfect tubes is usually 8 mm; the outer margin seems somewhat flared outward and backward in forming an approximately circular oscular opening with a diameter of

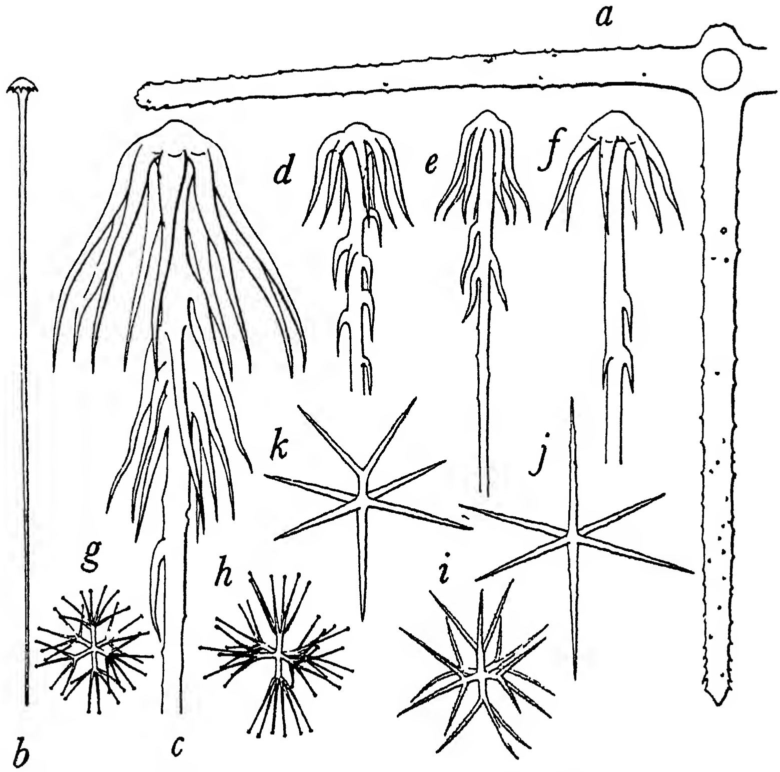


FIGURE 4.—*Farrea kurilensis*, new species. *a*, Dermal pentactin; *b*, circular umbellate clavulae; *c*, anchorate hooked clavulae (form A); *d*, anchorate hooked clavulae (form B); *e*, anchorate hooked clavulae (form A); *f*, anchorate hooked clavulae (form B); *g*, discohexaster; *h*, discohexaster; *i*, oxyhexaster; *j*, oxyhexactin; *k*, oxyhexactin. All × 250.

about 10 mm. The entire extended colony was attached on a plate of cirripeds by the entire base and not predominantly erect nor attached by special short or long peduncles as are other members of this genus. Whether the dichotomous division of the single tubular ends takes place is doubtful, as the outer margins of the tubes are damaged and imperfectly preserved. The dichotomous ramification begins at a very early stage at irregular intervals, resulting not in a long straight main trunk, but in an irregular twisted system of tubes, spreading in all directions, especially transversely.

Spiculation.—The dictyonal framework is supported by a single-layered network in most parts and occasionally by a two or more layered irregular network. The framework is always quadrangular in those portions near outer margins of the tubes and becomes irregular in the lower portions. The beams of the framework are micro-tuberculated on the surface. From the center of the crossing point of the beams, a prominent, fairly long, rough-surfaced, and nearly conical boss projects.

The dermal and gastral pentactins (fig. 4, *a*) of this species measure commonly 430μ to 460μ in length of the paratangential rays. The proximally directed, unpaired ray is usually the same as the paratangentials of the same spicule, except that they are slightly shorter. Near the center the rays are 12μ to 16μ thick. All the rays gradually attenuate toward the more or less conically pointed end. The surface is roughened except for a short distance near the center, the roughness becoming gradually more pronounced toward the ends.

The clavulae are, broadly speaking, of two kinds, namely, circular umbellate clavulae and anchorate hooked clavulae. The circular umbellate clavulae (fig. 4, *b*) are fairly abundant here and there, penetrating vertically to the surface, and form small bundles around the unpaired proximal ray of the dermal pentactin. There is no swelling on the shaft, except just below the umbel, which measures about 16μ in width and has 16 to 18 minute teeth on the periphery. The shaft is very slender and attenuated gradually to the pointed end, usually about 300μ long. The surface is sparsely roughened, the roughness being most pronounced on the swelling of the shaft, just below the umbel.

Several variations of the anchorate hooked clavulae occur in different regions of the same sponge. This variation is, on the one hand, associated with the shape of the terminal disk, and on the other, with its terminal spines. I distinguish two forms or varieties which are designated by the letters A and B.

Form A (fig. 4, *c*, *e*) is represented chiefly in the dermal layer and is arranged vertically to the dermal surface. It is large and strong and is provided with long curved spines, 48μ to 95μ long, forming a disk 64μ to 105μ broad across tips of spines, and 30μ to 40μ broad across the club-shaped basal swelling, which is externally roofed over by a hemispherically arched umbel, raised on the center into a projecting boss, or infrequently with a nearly smooth convex umbel. The shaft is generally simple, straight, 590μ to 680μ long, 8μ to 12μ broad at the base, and gradually attenuated toward the conically pointed end and covered with sparsely scattered spines on the distal end, while the proximal end near the terminal disk is covered with numerous strong, long, curved spines, projecting obliquely from the shaft.

Form B (fig. 4, *d*, *f*) appears chiefly in the gastral layer, occasionally intermixing with form A, arranged obliquely to the dermal surface. It is somewhat smaller and shorter, about 400μ to 450μ long. Its most striking characters are the shape of the terminal spines projecting from the periphery of the terminal disk and the shape of the lateral spines covering the proximal surface of the shaft. The terminal disk of this form is usually 25μ to 30μ broad, and its summit shows a generally hemispherically arched umbel, being raised in the center into a weak external projecting boss or rarely a simply smooth convexed surface. The spines on the periphery of the terminal disk are usually much shorter and nearly straight, not so curved as those of the preceding type. They are 30μ to 50μ long and 36μ to 75μ broad at the distal extension. The lateral spines on the proximal surface of the shaft are also much shorter; projecting perpendicularly at first, they are distally curved downward, instead of simply projecting obliquely as those of form A.

The uncinate is arranged perpendicularly or obliquely to the dermal surface. It usually penetrates the whole thickness of the body wall. It is acerate and nearly straight; the outer half, nearer the dermal surface, is always much thicker than the inner, narrowed and sharply pointed end, and is spined at short intervals throughout. These spines, which are all bent backward, are very short, slender, and smooth. They are supported by small, weak, bracketlike processes arranged around the shaft in a spiral. The uncinate measures about 1.3 mm long and exhibits some variability in length, though this depends to some extent on the age of the individual spicule and on the region of the sponge in which it occurs.

Discohexasters of this species are probably found in two forms. The common one (fig. 4, *h*), present in large numbers everywhere in the sponge, is 60μ to 80μ in diameter and is provided with rather strong principals crossing one another at the center, measuring 16μ in length. From these arise 6 to 8 thin, nearly straight, and weakly divergent terminals 20μ long and terminating with pinheadlike disks at the ends.

The other form (fig. 4, *g*) may be present occasionally in the parenchyme, intermingled with the former. It is somewhat smaller in size, measuring about 55μ in diameter. Each short principal is supplied with a bell-shaped, outwardly extending tuft of four to six terminals, differentiating it from the preceding. These are somewhat stronger, thicker, and fewer than those of the former form, and each terminates in a small circular pinheadlike disk.

The oxyhexaster (fig. 4, *i*) occurs more frequently than the discohexaster above mentioned, appearing chiefly on the dermal membrane and sparsely in the parenchyme. It measures on the average about

90μ in diameter. Its short, smooth, principal ray (8μ long as measured from the axial center) divides into 3 to 4 widely diverging, straight terminals, two or three times the length of the principal ray. These terminals have sharply pointed ends. Of the spicules irregularly scattered throughout the parenchyme, I will describe the oxyhexactin (fig. 4, *j*) and oxypentactin in addition to the above-mentioned spicules; the former seems to be more numerous than the latter. They are very numerous everywhere, in the choanosome, ectosome, and in the endosome. The oxyhexactin measures 130μ to 140μ in axial length and 6μ broad at the base. The rays are gradually attenuated to the sharply pointed ends, and the surface is sparsely roughened. The oxypentactin is of nearly the same size and has the same features as the former spicule.

FARREA WATASEI, new species

FIGURE 5; PLATE 3, FIGURE 1

There is but a single specimen (holotype, U.S.N.M. No. 22035) of this new species. It is fairly large and was obtained from a depth of 682 fathoms near Petropavlovsk in Bering Sea (Station 4797). The sponge is of a somewhat large, thick-walled, irregular, tubular configuration measuring 2 mm to 3 mm in the middle and becoming gradually more or less thinner toward edges. The characteristic dictyonal framework, which appears commonly in all members of the genus *Farrea*, is distinctly present in this specimen and is densely filled up by microscleres. The incurrent and excurrent canalar apertures are of nearly the same size and shape: mostly small and circular, 0.3 mm to 0.5 mm in diameter.

Spiculation.—The dictyonal framework of *F. watasei* for the most part consists of two or more layers. Infrequently it is in one layer, as in many other species of *Farrea*. In the many-layered dictyonal framework, the radial beams extend between the layers, which lie irregularly or parallel to one another. These radial beams somewhat resemble tangential beams in their cylindrical shape, though they are frequently roughened on the surface. The prominences, which project from the outer and inner surface of the whole latticework, measure 500μ to 600μ. They are always tuberculous. The length of these freely projecting conical prominences varies as much as their form within fairly wide limits. They are generally straight or somewhat curved terminally, slender and shorter in the younger portions, and longer on the surface of the many-layered framework of the older regions. The breadth of the beams varies considerably, from 60μ to 90μ.

Of the spicules in the loose parenchyme, which lies between the dictyonal framework, the uncinate is first described. It exhibits an

extraordinary variability in length, but is usually 3.5 mm long and 12μ broad at the middle. It is disposed obliquely or perpendicularly to the surface, traversing the wall of the tube in a radial direction, the proximal two-thirds imbedded in the body of the sponge. Though the tip does not usually penetrate the dermal membrane, it occasionally does for a third of its length. The inner weaker and pointed ends remain at some distance from the gastral membrane or reach it. The spines arranged around the shaft are very slender and short, supported on very weak bracketlike processes.

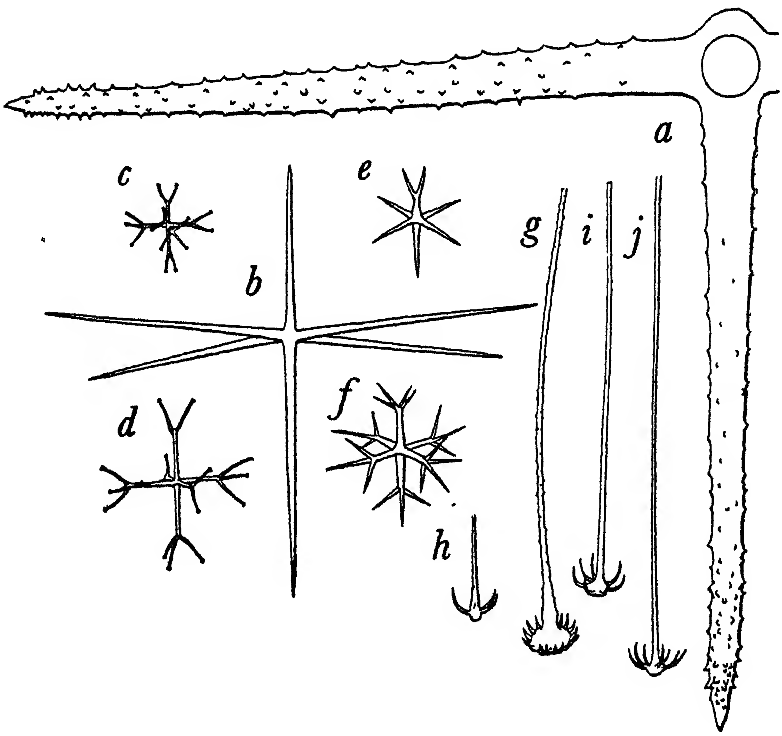


FIGURE 5.—*Farrea watasei*, new species: *a*, Dermal pentactin; *b*, hexactin; *c*, discohexaster (form A); *d*, discohexaster (form B); *e*, oxyhexaster; *f*, oxyhexaster; *g*, circular umbellate clavulae; *h*, anchorate hooked clavulae; *i*, anchorate hooked clavulae; *j*, anchorate hooked clavulae. All × 250

Besides the uncinates, parenchymalia are represented by simple oxyhexasters (fig. 5, *f*) in abundance, though they frequently occur in subdermal or subgastral regions, intermingled with discoctasters. In these the principal rays, which are long, smooth, and somewhat attenuated to the end, divide into two to three widely diverging, straight, short, smooth terminals, half as long as the principals. Terminals arising infrequently from the principals are reduced to only one in number (fig. 5, *e*). In certain cases one of the six rays

of the same spicule may be divided into two short terminals while the other principals are not divided at the end. From this form, I can ascertain that the oxyhexaster of the present species may be derived from the small hexactin, though the latter is not found in this sponge. Oxyhexasters measure 40μ to 70μ in diameter; the terminals are 8μ to 12μ long, and the principals are twice as long as the terminals.

Besides the uncinates and the oxyhexasters, the parenchymalia of the present species contain many simple hexactins and pentactins of much larger size, though they occur abundantly on subdermal regions and are sometimes nearly absent in the parenchyme.

Most of the hexactins (fig. 5, *b*) measure 160μ to 240μ in axial length; their rays are gradually attentuated to sharply pointed ends. The surface of the rays is slightly roughened. These spicules are sparsely distributed in the parenchyme, though much more abundantly in regions between the dermal pentactins. The pentactinic form appears rarely, intermingling with the former, and exhibits nearly the same structure as the hexactins.

The dermal membrane is supported by the four rectangularly intersecting tangential rays of the pentactins (fig. 5, *a*), whose unpaired proximal ray penetrates into the parenchyme vertically. Though the proximal ray is always perfectly straight and gradually narrowed into a conical form toward the pointed end, the four paratangential rays are frequently bent gently inward. Infrequently they are straight and end in a conical point. All the surfaces are roughened; and toward the ends of the rays the microspines increase in height and are more densely placed. The proximal ray usually does not exceed the tangential in length, measuring 200μ to 350μ in length and 30μ broad at the base. It is always cylindrical and somewhat smooth at a short distance from the base, with the exception of a strongly roughened end. The tangential rays are also cylindrical and usually somewhat longer, measuring 230μ to 380μ in length. The roughness of the surface is quite similar to that of the proximal ray.

The opposed tangential rays of these pentacts in the dermal membrane form a nearly quadratic framework. Frequently, also, they are irregularly arranged.

The gastral pentactins agree essentially with the dermal; so that I may simply refer to the above description of the latter and note only that the principal deviations are a somewhat smaller size and a somewhat less regular arrangement.

Discohexasters seem to be of two kinds, which are designated by the letters A and B. Form A (fig. 5, *c*) appears commonly in subdermal and in subgastral regions, and infrequently in the

parenchyme, while form B (fig. 5, *d*) is rarely found in subdermal regions. Much preparation and special research will be necessary to find it.

Form A measures 70μ to 80μ in diameter, and is provided with tolerably long, smooth principals, measuring about 20μ, which are divided into 2 to 3 short, straight, narrowly divergent terminals tipped with a small pinhead knob. Form B, which is found very rarely in subdermal regions, measures 90μ to 95μ in diameter and is characterized by fairly long S-shaped terminals, disposed in a perianthlike whorl tipped with a small knob.

Clavulae are of two kinds, namely, circular umbellate and delicate anchorate hooked; both occur in the dermal layer.

The circular umbellate clavulae (fig. 5, *g*) represent a common type that appears in many members of this genus. They occur rarely on the surface of the dermal layer, penetrating perpendicularly to the surface, close to the unpaired proximal rays of the dermal pentactins. The umbel is provided with minute teeth on the margin and is 20μ broad. The shaft is 200μ long, somewhat broadened just below the umbel, and gradually attenuated toward the conically pointed end. The surface is sparsely roughened, the roughness being somewhat pronounced on the proximal parts of the shaft.

Of the anchorate hooked clavulae two kinds of small forms are found. In one form (fig. 5, *i*, *j*) the shaft shows toward its upper end at most a gentle thickening, which bears terminally 6 to 8 delicate, slender, markedly recurved hooks, or teeth, producing a certain resemblance to an anchor. The so-called head frequently shows an external slightly raised swelling at the center which occasionally is entirely absent, then being represented merely by a convex surface. The shaft is 200μ long, and 3μ broad proximally. The head, at least, and the greater part of the shaft, are partly destitute of the roughness so frequent in the circular umbellate clavulae.

In the other form (fig. 5, *h*) the end of the shaft makes a prominent conical swelling, from which 3 or 4 slender curved hooks project. This form occurs infrequently in the dermal layer, intermixed with the former, and measures 200μ in length. The shaft is entirely smooth and totally devoid of lateral spines.

FARREA SOLLASII F. E. Schulze

Farrea sollasii F. E. Schulze, Rep. Voy. *Challenger*, vol 21, p 281, pl. 74, figs. 1–6, 1887.

There is a single specimen in the collection that may be identified as *F. sollasii*. It was collected from a depth of 197 fathoms at the entrance to Uraga Strait, between Jôgashima and Okinosé in Sagami Sea (Station 5091). I wish to call attention here to the numerous larvae of this species that were found in the maternal sponge body.

Ijima in his Contribution III, page 42, speaks of the spherical larva of *Leucopsacus orthodocus*, and in his Contribution IV, page 46, of the spindle-shaped ones of *Vitrollula fertilis*. The present larvae are also spindle shaped, and I consider them larvae in an early stage of development.

Our spindle-shaped larvae measure 100μ to 105μ in breadth and 220μ to 250μ in height. It was not possible to give a detailed account of them, as my preparations were not sectioned and the specimens were poorly preserved. The macrosclere, which first makes its appearance in the larva, is a minute and delicate-rayed oxystauractin. The spicule is situated on the surface, with the plane of the four rays disposed paratangentially to the surface of the larva. The longer distal and proximal rays cross or join each other at both ends of the other oxystauractins on both peripheral ends of the larva. Their smooth, greatly tapering longer proximal and distal rays with the sharply pointed or somewhat inflated ends may be 95μ to 100μ long, and the shorter paratangential rays measure 60μ in length. The epithelial covering is entirely concealed from view.

FARREA SOLLASII YAKUSHIMENSIS, new subspecies

Specimen A (holotype, U.S.N.M. No. 22036) is much branched, forming composite masses, and measures 25 mm in height and 50 mm in breadth. It exhibits a somewhat narrow-meshed tubular framework, which was fixed to a substratum by means of a few compact pedicles. In inferior regions of the sponge body in parts near the pedicles, most of the soft parts are macerated, and only the dictyonal frameworks are complete. The constituent tubes are 2 mm to 3 mm in breadth and open out by means of short projecting terminal branches. In external appearance this specimen seems to be allied to the members of *Eurete*.

TABLE 12.—*Record of specimens of* Farrea sollasii yakushimensis

Specimen	Collected at—	Description
A	Station 4924, 18 miles SW. of Yakushima, 159 fathoms	Large.
B	do	Small
C	Station 4929, 10 miles S. of Yakushima, 84 fathoms	Do

Specimen B is much smaller and poorly preserved; nearly all the soft parts are macerated. The body is attached to a stone by a short pedicle. The height of the specimen is 25 mm, and the broadest part, which is at the distal end of the sponge body, measures 23 mm.

Specimen C, preserved in alcohol, is attached to a stone by the broad base measuring 8 mm. Although the greater part of it is so completely macerated that only the dictyonal net is left, the soft

parts are sufficiently preserved to make it possible to study the isolated spicules. It is 11 mm in height and 13 mm in breadth.

The chief difference from typical *sollasii* lies in the total absense of large onychasters and oxyhexasters, as well as in the presence of the much smaller circular umbellate clavulae. The discohexaster of the present subspecies is much smaller, measuring 40μ to 45μ in diameter, and has a somewhat stronger and much shorter terminal. Of the circular umbellate clavulae, some deviations occur in different regions of the same sponge. This variation is chiefly associated with the swelling on the shaft, just below the umbel. In many cases the swelling is conspicuous; occasionally it is totally lacking or is inconspicuous. The roughness of the surface is much pronounced on the swelling or on parts just below the terminal umbel. The anchorate hooked clavulae are quite delicate. They have 8 to 10 weakly developed, slender, hooklike spines, widely diverged externally, and 55μ to 57μ in breadth at the lower extension. The shaft is slender, smooth on the surface, gradually attenuated to the pointed end, and 450μ long and 8μ broad just below the umbel. The four tangential rays of the dermal pentactins are much more distinctly tuberculous and somewhat broader than those of the typical form.

FARREA BERINGIANA, new species

FIGURE 6; PLATE 3, FIGURE 5

Several large and small fragments (U.S.N.M. No. 22037) which may represent parts of the lateral wall of a sponge body, were collected from a depth of 64 fathoms, off Bering Island, Bering Sea (Station 4790).

Though both the shape of the sponge and its spiculation might warrant establishing a new genus for this material, and indeed I find that the entire spiculation, particularly the dictyonal framework and total absence of umbel clavulae, is completely different from what we find in other species of *Farrea*, I venture to retain it in the present genus. Instead of the network and tubular sponge body, which occur in many species of *Farrea*, there is here the moderately soft, fairly thick, compact wall of a large cup. The sponge body was broken into several fragments 30 mm to 34 mm broad, and accordingly the complete outer configuration could not be studied. Yet I believe that the body does not form the framework of a slender tube, as in many species of *Farrea;* it rather seems to form a somewhat larger cup or tube.

The gastral membrane, which is quite clearly visible in alcoholic specimens, extends over the whole inner surface in the form of a delicate skin. A quadrate, latticelike network, formed of opposed dermalia or gastralia, is entirely absent on all sides of both mem-

branes, which have an irregular streaky appearance, though the dictyonal framework is visible from the outside.

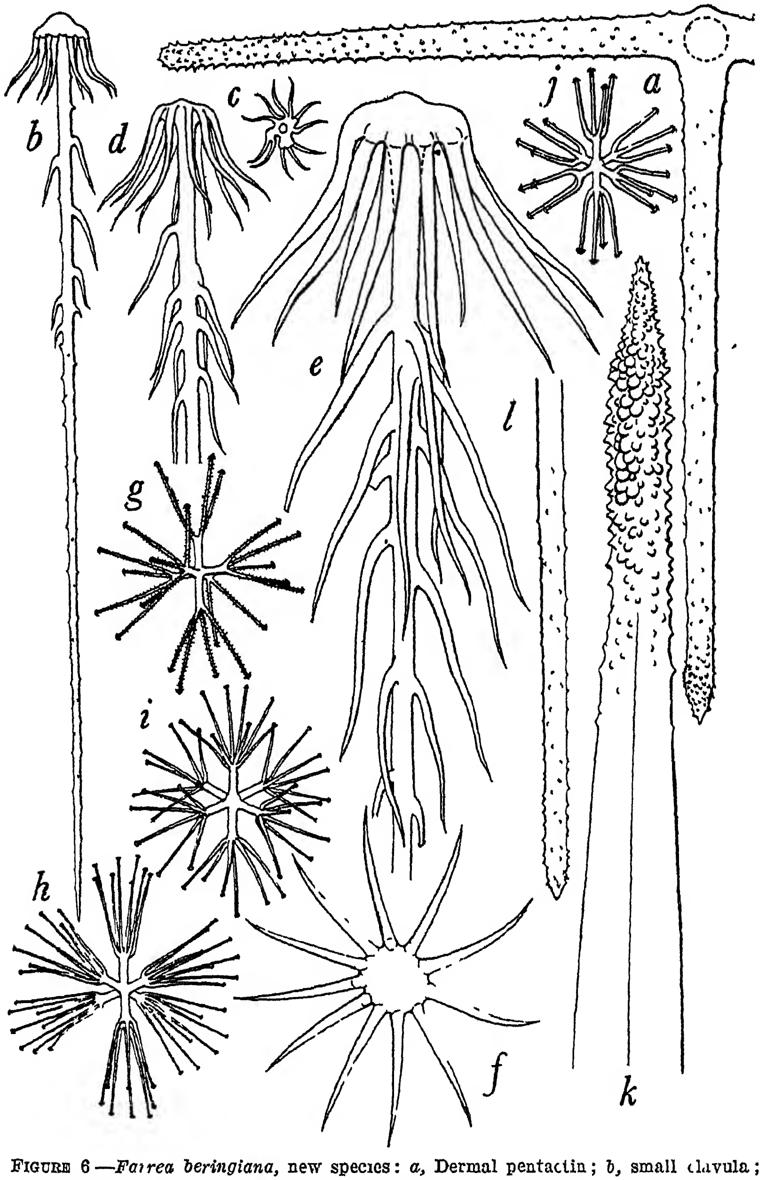


FIGURE 6.—*Farrea beringiana*, new species: *a*, Dermal pentactin; *b*, small clavula; *c*, upper view of head of small clavula; *d*, small clavula; *e*, large clavula; *f*, upper view of head of large clavula; *g*, tylohexaster; *h*, tylohexaster; *i*, tylohexaster; *j*, discohexaster; *k*, large extremity of diactin; *l*, small extremity of diactin. All × 250

Spiculation.—The dictyonal framework exhibits notable variations in the different regions of the plate, but chiefly forms perfectly square or rectangular meshes of variable sizes. Most of the beams

of the framework are smooth on the surface. They are frequently beset with tubercles on the longitudinal beams and are fairly slender, measuring 34μ to 50μ in width, and are curved. The moderately long and curved, free-projecting prongs, or conical pegs, are 4 mm to 1.7 mm long, rough and tubercled on the surface, and project from the inner or outer side, frequently laterally from the median beams.

The dermal membrane is supported by the four rectangularly intersecting tangential rays of pentactins (fig. 6, *a*), whose unpaired proximal ray penetrates into the parenchyme vertically. Though the proximal ray is always perfectly straight and slightly roughened on the surface, the tangential rays are somewhat curved inward and more roughened on the surface, with the roughness much more pronounced toward the end of the rays. The proximal ray, which is usually much longer than the tangential, measuring 340μ to 510μ in length and 16μ to 24μ broad near the center, is somewhat smooth at a short distance from the center. The tangential rays are usually more or less shorter, 280μ to 320μ long, and slightly curved inward. These pentactins on the dermal membrane are very irregularly arranged, though sometimes they form a quadratic framework. The gastral pentactins agree essentially with the dermal.

The clavulae are a kind of hooked anchorate. Their size variation is considerable in different regions of the same sponge. This, on the one hand, is chiefly associated with the total sizes of the spicule and, on the other, is partly associated with the number of the protruding teeth on the periphery of the head. These deviations merge into one another through forms of intermediate size and shape.

The larger clavulae (fig. 6, *e*, *f*), which occur mostly on the dermal layer and occasionally on the gastral layer, penetrating obliquely or lying on the surface, are 1 mm to 1.7 mm long. The head, 50μ to 70μ in width, shows a convex, smooth surface with an external, slightly raised swelling at its center. It is usually provided with 10 to 14 strong, externally curved or nearly straight teeth 140μ long, forming a large bunch 200μ broad at the distal expansion. The shaft is gradually attenuated to the conically pointed end, measuring 12μ to 16μ broad on parts just below the head and 8μ broad near the end. The curved or nearly straight lateral spines project from the proximal parts of the shaft. They are 80μ to 105μ long, their length gradually decreasing downward.

The smaller form (fig. 6, *b*, *c*, *d*), measuring 760μ to 850μ long, is much more abundant on the gastral and dermal layers, penetrating vertically to the surface, exposing only its head from the surface or being immersed entirely into the body wall. The head is much smaller, measuring 20μ in diameter, and its surface is quite smooth and convex or weakly raised at the center. In some of these forms the spines projecting from the periphery of the

terminal disk are arranged in a spiral manner and are not so regular as in those of the larger ones.

In the hypodermal and hypogastral layers, the prominent tylohexasters (fig. 6, *g*, *h*, *i*) are abundant but are not so numerous in the parenchyme, being sparsely distributed, intermingled with discohexasters derived by reduction and stoutness of terminals from the former. The tylohexaster of large rosettes, which possess terminal rays bearing pinheadlike disks at the ends, exhibits the typical number of principal rays, since as a rule six are present. At the slightly expanded outer end they divide into 6 to 15 straight or somewhat S-shaped terminals, which diverge slightly in a tuft and attain a length about double that of the principals. Each terminal, smoothed on the surface, bears at its extremity a small pinheadlike disk. The tylohexasters vary considerably in size, measuring 80μ to 150μ in diameter; the larger ones occur mostly in the ectosome, while the smaller ones are present in the choanosome. Two other kinds of spicules, which are considered derivatives of the normal tylohexaster above mentioned, are found rarely in the parenchyme. I therefore do not give special descriptions of them.

Frequently I have found a discohexaster (fig. 6, *j*) intermingled with the tylohexasters, mostly in the ectosome, with 3 to 4 robust gently curved terminal rays. The curvature of the terminal rays usually assumes an S-shaped form and results in the formation of strong, three or four rayed perianthlike whorls at the end of the principal rays.

Uncinates of *beringiana* usually penetrate the dermal surface obliquely, though they are sometimes perpendicular to it. They vary in length and thickness, measuring 1 mm to 1.5 mm long and 8μ broad at the center, and are surrounded by fine barbs.

The large diactins (fig. 6, *k*, *l*) in the hypodermal regions show a character peculiarly different from those of other members of the genus. They may attain a length of 9 mm, measuring 70μ broad at the center and gradually attenuating to a conically pointed end. The entire surface of the spicule is nearly smooth, except at both ends where the surface is sparsely roughened by microspines, though that of the larger one is distinguished by larger and more densely distributed microtubercles.

INDETERMINABLE FARREA

There is in the collection a small colony of specimens of *Farrea* collected by the *Albatross* and not determinable specifically. It is completely macerated and as it would be futile to describe it in detail, I merely give the following record of it:

Station 4768 ("Bowers Bank," Bering Sea). Small macerated colony.

Subtribe SCOPULARIA F. E. Schulze, s. ext.

Family EURETIDAE F. E. Schulze, s. ext.

Genus EURETE Semper, 1868

EURETE NIPPONICA, new species

PLATE 3, FIGURE 3

Among the specimens of *Eurete* collected, a single small injured specimen (holotype, U.S.N.M. No. 22038) appears to represent a new species. It was obtained at Station 4893 (10 to 20 miles southwest of the Gotô Islands, 106 fathoms). This small and erect sponge arising from the slender tubular basal region measures 25 mm in height and about 24 mm in breadth. At the upper end there are irregular, radial tubes about 5 mm in diameter, most of which are injured at the apertural margin. The soft parts are sufficiently preserved in places to enable one to recognize the microscleres.

In spicular characters *Eurete nipponica* closely resembles *E. marshalli*, differing from it in the thickened spinose nodes at the intersections of the dictyonal beams and in having onychasters in the parenchyme. The onychaster may be considered as a derivative of the discohexaster, though, as I have demonstrated, this form may be derived from an oxyhexaster.

The dictyonal net forms a regular to irregular triangular or quadrangular honeycomb. The beams composing it are nearly covered with conically pointed small tubercles on the entire surface. Everywhere in the lower, older regions of the specimen the dictyonal network forms a thicker layer. It is stronger and is covered entirely with many more, stout tubercles. At the dermal and gastral margins, on the surfaces bounding the honeycomb cavities, most of the nodes appear distinct, round, and thickened, showing a strawberrylike form, though much more prominently formed on the dermal than on the gastral regions.

The dermal membrane is supported by pentactins with paratangential rays 160μ to 200μ long, which are nearly straight or bent inward, gradually attenuated toward the conically pointed or round ends, and covered with microtubercles on the surface, being somewhat pronounced at the ends. The proximal radial ray is somewhat shorter in length, is gradually attenuated to the slightly roughened, conically pointed end, and usually bears densely distributed, small pointed tubercles.

The gastralia are also pentactins, which show nearly the same features as the dermalia, though they have more inwardly curved tangential rays.

The scopules are numerous and arranged perpendicularly or obliquely to both surfaces; they are rather abundant in the dermal layer and are variable in shape. They usually have four branches, which lie close to the center of the pentactins, where the proximal unpaired ray is given off, and which nearly reach the surface. The shaft is generally simple, smooth, straight, 20μ to 210μ long, and gradually attenuated toward the pointed, roughened end. It is always rough terminally, but for the rest of its length nearly smooth. Though the number of branches is subject to considerable variation, they are most commonly 4 in number. They arise from a comparatively short thickening at the distal end of the shaft. The basal part of each branch is thin, about 52μ long, and extends upward, bending slightly outward. Toward the end it is thickened in a club-shaped manner and is sparsely covered with spines, small and indistinct at the base, larger toward the distal end, and directed backward.

Uncinates, varying in length and thickness, are quite frequently found close to the dictyonal honeycomb. They are arranged perpendicularly, occasionally obliquely, to the surface and usually penetrate the whole thickness of the sponge wall. The outer half of the spicule, nearer the dermal surface, is always thicker than the inner half (nearer the gastral surface), which is gradually attenuated to a pointed end. They are mostly 85μ long and 8μ to 15μ broad at the thickest part of the outer half of the spicule. The spines projecting from the entire surface of the spicule are arranged densely but irregularly.

Much more peculiar and worthy of interest are the hexasters scattered in varying numbers irregularly through the parenchyme. Their shapes and sizes differ in different regions of the same individual.

The onychasters are 45μ to 55μ in diameter. From each short principal there arise three or four thin, tapering, nearly straight, considerably divergent terminals. The terminations of the branch ray bear a verticil of fine claws, usually four in number. These are of small size, and subject to little variation. The claws are horizontal to the branch ray or extend obliquely downward, and are slightly recurved. Sometimes, perhaps less often, they extend obliquely upward at the end of the terminals. These probably are not senile structures, as they are produced in all hexasters of the present species and are undoubtedly derived from the oxyhexaster by the transformation of the extremities of the terminals.

True oxyhexasters occur more abundantly than the former onychasters, and the latter may be easily overlooked unless a special search be made for them. Sometimes it was difficult to find even a single onychaster between the numerous oxyhexasters; sometimes

both were present in nearly equal numbers. The onychasters are only occasionally present in parenchymal regions. In the oxyhexasters, the diameter is usually 50μ to 75μ. The principals are of moderate length and relatively slender, being about 8μ to 10μ long, as measured from the central point of the axial cross. The slightly swollen end of the principals bears 3 to 5 terminals in a diverging tuft, smooth, tapering, generally nearly straight, but frequently curved outwardly near the end. These spicules mostly occur on the subdermal regions and closely resemble in general appearance those occurring in *E. marshalli.*

EURETE SACCULIFORMIS, new species

PLATE 3, FIGURES 6, 7

Five complete colonies (cotypes, U.S.N.M. No. 22039) and two other fragments of *E. sacculiformis* are in the collection. They were obtained 10 to 20 miles southwest of the Gotô Island (Station 4890), at a depth of 135 fathoms, together with *Aphrocallistes beatrix orientalis* Ijima.

One entire specimen forms a hemispheroidal mass, which has a diameter of 30 mm to 40 mm and a height of 24 mm to 35 mm. It is attached at the base. The surface is plainly flattened by short inferiorly expanded peduncles. The lobes are usually about 5 mm thick, and the sponge appears as if it had been produced by a continued branching and anastomosing growth that started from centers of the lower regions. The oscula are about 3 mm in diameter and are bounded by a thick wall, not thinned out at the margin as is usual in members of the present genus. (It is difficult to ascertain the true features in greatly broken specimens.)

The surface of the sponge appears slightly porous, owing to the numerous afferent canals. In spots, especially in the oscular margin of the tubes, the afferent canals are nearly closed, and the surface has a heterogeneous appearance.

Spiculation.—The dictyonal net forms an irregular and nearly uniform honeycomb. The hexactinic dictyonalia, which are joined in a regular manner, form a net or latticework with irregular triangular or quadrangular meshes. Fairly long, tuberculous, cylindrical processes protrude from the dermal and gastral surfaces. Those protruding from the dermal surface are distally expanded in a knoblike swelling and are quite densely tuberculous, while those protruding from the gastral surface are conically pointed and sparsely roughened. The beams composing the dictyonal net are sparsely covered with small pointed tubercles. They are 100μ to 120μ broad at the middle, becoming broader at their intersections.

The dermalia are nearly smooth pentactins. The rays vary from 160μ to 190μ in length, as measured from the center, and are 16μ thick at the middle. They taper outward slightly, or not at all, and end somewhat rounded or expanded. The paratangential cross is usually—but not always—slightly convex, as the rays themselves. On the surface, the dermal latticework presents irregular meshes, though in places these show a tendency toward an irregular quadrate arrangement. All the rays are nearly smooth on the surface, except on the thickened, rounded end, which is covered with densely distributed tubercles.

The gastralia are also pentactins, though they are somewhat different in shape and size from those of the dermalia. The paratangentials measure 180μ to 200μ in length, while the proximal unpaired ray is somewhat longer, measuring 200μ to 250μ. All the rays are quite straight, not arched convexly as in the dermalia, and gradually attenuated toward the conically pointed and roughened ends.

Scopulae are represented by two kinds, one being a larger, robuster, and much more abundant form than the other. It has four terminal branches, which lie between the proximal radial rays of the dermal hexactins and nearly reach the surface, arising from an inconspicuous, short thickening at the distal end of the shaft. The basal part of each branch is uniformly thick, sparsely covered with microspines and slightly divergent outward. Toward the end, branches are thickened in a spherical knob-shaped manner. It is also densely covered with spines, large and distinct at the base, directed backward, and smaller toward the distal convexed surface. The shaft is generally simple, straight, 300μ to 400μ long, and gradually attenuated toward the pointed and roughened end.

Of the other kind of scopulae, two to four branches also project at the tip of the shaft; but they are different from the scopulae described above, as follows: The distal thickening of the shaft is very prominent, nearly spherical, and the two to four branched rays arise from its margin and diverge somewhat prominently outward. They are nearly cylindrical, measuring 30μ to 40μ in length, somewhat thin at the base, and gradually thickened at the end. They terminate in a small spherical knoblike swelling densely covered with microspines which are larger at the base and directed backward.

The onychasters are fairly numerous in the choanosome. They are slender rayed and rather small, 40μ to 70μ in diameter. Each short principal bears two or three, sometimes four, terminals, which are widely divergent, quite straight, thickest at the base, and gradually thinned out toward the end. They are quite smooth on the surface. The tip carries two fine prongs. Unlike the claws in a true onychaster, these are generally directed obliquely forward and outward.

The small circular nodule from which the very short principals arise is not formed as in most cases, the onychasters merely intersecting at the center.

Uncinates show the usual features common to members of the present genus. They measure 2.5 mm in length and 8μ broad at the center.

EURETE SCHMIDTII F. E. Schulze

Eurete schmidtii F. E. SCHULZE, Rep. Voy. *Challenger*, vol. 21, p. 293, pl. 78, figs. 1–6, 1887.

Of *E. schmidtii* there are four nearly complete small colonies and single small fragments, which are somewhat macerated and injured at the extremities of the tubes. They were obtained from two stations not far apart near the entrance to Enoura, Suruga Gulf (Table 13).

TABLE 13.—*Record of specimens of* Eurete schmidtii

Lot	Collected at—	Number and description
A ..	Station 5069, entrance to Enoura, Suruga Gulf, 131 fathoms	Two, nearly complete, small
B	Station 5070, entrance to Enoura, Suruga Gulf, 108 fathoms	Two, nearly complete, but macerated; one small fragment

The outer configuration of our specimens closely resembles that of the type specimens. Unfortunately the basal portion supporting the entire colony, described for a Japanese specimen by F. E. Schulze in his *Challenger* report, is entirely absent here. On some of the specimens there were numerous small Actiniae irregularly scattered about as already recorded for the present and other species by other authors.

Besides the common typical oxyhexaster of this species two other kinds of spicules are found intermingled with the former; the one is nearly similar to that occurring in the *Challenger* type, being somewhat different in the number of terminals and in the manner of their curvature. Of less frequent occurrence is the other kind of oxyhexaster of nearly the same size, which differs from the first in having a distinct central knob and widely divergent terminals, which are not curved outwardly at the ends. Of more frequent occurrence are the medium-sized oxyhexasters with simple principal rays of medium length, and with 2 to 3 outwardly bent or nearly straight medium-sized terminals, as in the type specimens. The terminal rays are usually twice as long as the principals of the same spicule. The oxyhexaster in question is entirely similar to that occurring in *Periphragella elisae* Marshall. (*Challenger* Rep., pl. 81, fig. 5.)

The 2 to 4 terminal barbs of the much more numerous scopulae are somewhat different from those of the type specimens. They are rather weakly developed at the base, but gradually increase in diameter at the middle and again decrease, being extremely attenuated toward the sharpened spinous end.

EURETE IRREGULARIS, new species

PLATE 3, FIGURE 4

At Station 5030, two small sponges (cotypes, U.S.N.M. No. 22040) were taken. Owing to the fact that the microscleres had not been totally lost, the specimens are fairly well preserved. One of the bodies is an irregularly shaped tube 28 mm long with a greatest transverse diameter of 16 mm. The wall is about 3 mm thick, slightly thinning out above to an opening of the tube. The other sponge is also tubular in form but variously divided. There is no basal plate. In neither specimen is the upper end of the sponge preserved, and it may be seen that the axis is not dichotomously prolonged into branches, but remains single. Parts of the edge of cup may be flared out or may simply project toward one another.

Spiculation.—The dictyonal net forms a regular elongated quadrangular honeycomb. The beams composing it are quite smooth and approximately of the same breadth (70μ to 90μ) throughout the entire length. The rather slender processes, which become gradually attenuated toward the ends of the conically pointed beams, protrude from the dictyonal net toward the dermal and gastral surfaces.

The dermalia are pentactins, which are commonly supplied with a bosslike rudiment of the distal sixth ray. The rays are rather strong, 220μ to 250μ in length (as measured from the center), especially the proximal, unpaired ray, which is twice as long as the paratangentials, and 12μ in thickness at the base. Their surface is beset throughout with obsolete microspines growing more prominent toward the end and thinner toward the base of the rays and the central node. They taper perceptibly from the base toward the conically pointed or rounded end. The paratangential cross is usually much more convex on the inward surface, which is due to the curvature of the rays themselves.

The gastralia are also pentactins, resembling the dermalia. The rays are similar to those of the dermalia, except that the paratangentials are usually not so curved convexly, being nearly straight.

Much more peculiar and worthy of interest are the onychasters scattered abundantly in the parenchyme. Their shape and size differ in different regions of the same individual.

The onychasters themselves vary greatly in the length and the number of rays. The normal onychaster usually measures 70μ to 80μ

in axial length. The short principals are 12μ long and generally bear three widely divergent terminals, which are 24μ in length, nearly straight or slightly bent, and thickest at the base, thinning out to a very fine caliber toward the end. They are quite smooth on the surface. In the same spicule all the claws are similar in shape and of nearly equal size.

Transitional forms connect them with the normal onychaster, and they all occur in the parenchyme. Sometimes all the principals are supplied with two, occasionally three, terminals, and at other times they are either hemihexactinic or quite hexactinic forms, showing an increase in diameter (65μ to 95μ in diameter) over normal forms. The tip of the terminal branches is without a trace of a disklike expansion but bears a whorl of two or three short and exceedingly fine prongs, directed obliquely backward.

Scopulae are of one kind, forming delicate spicules 300μ to 350μ long in the entire length. They are arranged perpendicularly to the surface, forming a bundle around the proximal ray of dermal pentactins, their terminal branches protruding forward from the sponge wall. The shaft is generally simple, straight, 280μ to 300μ long, and gradually attenuated toward the conically pointed end. All the surfaces are quite smooth. The number and shape of the terminal branches are subject to considerable variation. They are slender, 4 to 8 in number, 30μ to 45μ long, nearly the same breadth throughout, and quite smooth on the surface. They arise from a prominent thickening at the distal end of the shaft, which is provided with three or four weak protuberances on the surface, 8μ in breadth. They run nearly parallel or slightly divergent on the whole. The most characteristic feature of the spicule is the distal thickening of the shaft, which has several protuberances on the surface.

A most peculiar feature of the species is the total absence of uncinates. I have searched particularly for them in all the preparations, but I must confess that I am still in doubt regarding them.

EURETE FARREOPSIS Carter

Eurete farreopsis CARTER, Ann. Mag Nat. Hist, ser. 4, vol. 19, p. 122, pl. 9, figs. 1–7, 1877.—F. E SCHULZE, *Challenger* Rep., vol 21, p. 295, pl. 79, figs. 5–8, 1887.

A single small, almost completely preserved, specimen and several fragments of *E. farreopsis* were collected from two stations. (Table 14.) The species resembles *Pararete carteri* in essential spiculations, except for the curved terminal branches of scopulae and for the much more delicate discohexaster. The specimens in question deviate from the type specimens as follows, but these variations are deemed too slight to warrant the establishment of a new species:

TABLE 14.—*Record of specimens of* Eurete farreopsis

Lot	Collected at—	Number and description
A	Station 4890, 10-20 miles SW. of Gotô Islands, 135 fathoms	Several fragments.
B	Station 4934, off Kagoshima Gulf, 103 fathoms	One, nearly complete.

Of the scopulae the sharp brakelike bend of the terminal branches, which characterizes the spicules of the species, does not constantly occur, some scopulae being occasionally found with straight terminal branches, as in *P. carteri*. In addition to the common discohexaster like that in the typical species, another with widely divergent terminals is occasionally found scattered in the parenchyme as well as in the hypoderm.

The greatest variations of the spicules of this sponge are to be found in the free hexactins, which are abundant in the parenchyme, but these variations in spiculation are correlated with the parts or regions of the sponge body where they enter into the formation of the dictyonal framework.

Genus PERIPHRAGELLA Marshall, 1875

PERIPHRAGELLA ELISAE Marshall

Periphragella elisae MARSHALL, Zeit. Wiss. Zool., vol. 25, suppl., pp. 177-180, pl. 12, fig. B, 1875; Zeit. Wiss. Zool., vol. 27, p. 123, 1876.

A large nearly complete specimen, resembling in outer configuration the *Challenger* specimen brought from Enoshima, Japan, by Döderlein, was obtained from a depth of 369 fathoms in Sagami Bay, near Jôgashima (Station 5088). It has the form of a nearly straight cup, or funnel, 137 mm in length, and rises, with a round hollow stalk of 16 mm diameter, from an irregularly formed basal plate 40 mm broad, and gradually expands upward toward the round terminal opening, which is 40 mm in diameter. Most of the narrow tubular branches, which project externally from all the surface, are injured toward the ends of the tubes.

The discohexaster in the parenchyme differs slightly from that of the type specimens in having broad, long principals. From these arise five or six short but strong terminals, which are half as long as the principal. Distally they are weakly bent outward, becoming perianthlike in shape. On the form of the discohexaster the *P. elisae* from Japanese waters, described by Schulze in the *Challenger* report, ought to be separated from the typical species, as it has long, slender, widely divergent terminals, nearly twice as long as the principals.

Family APHROCALLISTIDAE J. E. Gray, 1858

Genus APHROCALLISTES J. E. Gray, 1858

APHROCALLISTES BEATRIX ORIENTALIS Ijima

PLATE 4, FIGURE 1

Aphrocallistes beatrix orientalis IJIMA, Annot. Zool. Japon., vol. 9, pt. 2, pp. 173–182, 1916.

Many complete colonies and fragments that may be identified as *A. b. orientalis* Ijima were obtained from the several stations mentioned in Table 14, all of which, except Station 5092, are close together. In these specimens I have found certain differences in spiculation from the type specimens. In specimens D, the macroscleres and microscleres show a comparatively much more delicate form than those of the typical species. The distal ray of the dermal pinules, especially, is slender and is provided with weak lateral spines. Furthermore, the oxyhexasters also have much slenderer terminals. In the parenchymal regions of these sponges I have occasionally found hexactins of variable sizes, which may be of some consequence in the formation of the dictyonal framework.

TABLE 14.—*Record of specimens of* Aphrocallistes beatrix orientalis

Specimens	Collected at—	Number and description
A	Station 4890, 10–12 miles SW. of Gotô Islands, 135 fathoms	Three, nearly complete; seven fragments
B	Station 4894, 10–12 miles SW. of Gotô Islands, 95 fathoms	Small macerated dry fragments.
C	Station 4895, 10–12 miles SW. of Gotô Islands, 95 fathoms	Two, macerated
D	Station 4934, off Kagoshima Gulf, 153 fathoms	Two, macerated and injured.
E	Station 4937, in Kagoshima Gulf, 58 fathoms	Four, macerated and injured.
F	Station 5092, entrance of Uraga Channel, 70 fathoms	One, macerated.

Specimens A are fine and uninjured. The fully developed form is a tube gradually widening upward, with numerous radial glove-fingerlike swellings on the lateral walls. The axis of the entire tube, which may attain a length of 87 mm or more, as a rule has a slight curvature. The inferior extremity, which is firmly attached to the substratum, has the form of short peduncles, which are 5 mm to 7 mm in breadth. The length of these diverticula, which always end in a small circular osculum, as measured on the outer end of the tube, is in most cases 9 mm, but gradually decreases in the middle and upper parts to a length varying from 3 mm to 5 mm. Very frequently much elongated diverticula occur here and there at a distance above the base. These are bent obliquely downward, occasionally

reaching the firm substratum as if they were used for supporting the entire sponge. I have found many cases in which the diverticula are arranged in more or less longitudinal rows usually nine in number, which in inferior parts of the entire tube are arranged in a cruciate manner. Above, this arrangement becomes indistinct and irregular. Where the upper terminal opening with its natural margin is present and uninjured, it is closed by a transversely stretched narrow-meshed latticelike plate. The latter is somewhat concavely incurved, or occasionally not curved, and united to the honeycomblike lateral wall. In a few cases this latticelike transverse partition occurs in the interior of the tube, as already reported by Schmidt and Marshall. I agree with Schulze's opinion regarding its formation and significance, as mentioned in his *Challenger* report. There is some doubt in regard to the onychaster of specimens described by other authors. In the specimens of the *Challenger* expedition, Schulze does not describe the onychaster, while in the specimen from Andamans in the Indian Ocean, he reports it for this species. On the other hand, the discoctaster was mentioned by him in the former specimen and not in the latter. At any rate the spicules in question are present in all the specimens before me.

APHROCALLISTES INTERMEDIA, new species

Three fairly large, macerated fragments and several well-preserved fragments (cotypes, U.S.N.M. No. 22121) of this species were collected from two stations (Table 15).

TABLE 15.—*Record of specimens of* Aphrocallistes intermedia

Specimens	Collected at—	Number and description
	Station 4803, about southeast of Shimushir Island, Kuriles, 229 fathoms.	Three, fairly large, macerated fragments.
	Station 4804, about southeast of Shimushir Island, Kuriles, 229 fathoms.	Several well-preserved fragments, including the sieve plate

I have some doubt as to whether *intermedia* should be placed under *Aphrocallistes* or whether a distinct genus should be erected for it. The characters distinguishing it from *Aphrocallistes* are found in the presence of scopulae on the gastral regions and in the existence of a peculiar gastral oxyhexaster. The species is generically associated with *Aphrocallistes* rather than with *Chonelasma*, because it has diactins in the subgastral regions.

Spiculation.—The dictyonal net forms a regular and nearly uniform hexagonal honeycomb. The hexactinic dictyonalia are joined in a regular manner to form a net or latticework with nearly quadrangular meshes. Slender, faintly tuberculous, short, cylindrical

processes protrude from the dermal and gastral surface. The beams composing the net are nearly smooth and measure 20μ to 40μ broad. The nodes are very slightly or not at all thickened, and are only sparsely covered with small tubercles.

The dermalia are strong hexactins, with a free distal ray 180μ to 200μ long. They are terminally thickened in a club-shaped manner with stout spines, or thorns, of medium length, which diverge obliquely and are curved toward the end of the ray like the branches of a Lombardy poplar. The tangential rays are simple, straight, strongly tuberculous at the conically pointed ends, and much shorter than the distal ray, measuring 130μ to 150μ in length. The proximal ray is similar in shape but generally somewhat shorter. These hexactins are arranged regularly in quadratic meshwork, formed by the paratangential rays of the spicule.

The gastralia are stout, straight, occasionally slightly curved, somewhat flattened diactins, with a defined swelling at the center. Their ends are conically pointed or infrequently rounded and covered densely with small pointed tubercles. The spicule is always covered with such protuberances in its entire remaining length. The length of spicule varies considerably, measuring from 0.8 mm to 1.2 mm or more in length. The spicules are irregularly scattered on the gastral layer.

Scopulae are numerous, arranged perpendicularly to the surface or scattered irregularly in the parenchyme and sometimes distributed perpendicularly to the wall of the incurrent canals. The four to six branches of the scopulae perpendicular to the surface of the sponge lie between the proximal rays of the dermal hexactins and do not reach the sponge surface, except the extremity of the proximal ray. Elsewhere in the sponge they have no definite arrangement. The shaft is generally simple, straight, 160μ to 210μ long, and gradually tapering toward the pointed end. It is always slightly rough on the surface except at the end, which is frequently smooth. The number and shape of the branches are subject to considerable variation. Usually four stout or slender diverging dermal branches are observed. They arise from a comparatively short thickening at the distal end of the shaft and extend upward toward the distal ends, being nearly parallel to one another. They are nearly cylindrical, slightly thickened in a knot-shaped manner at the distal end, and uniformly densely covered in their entire length with very minute spines directed obliquely backward. The terminal thickening is covered with similar but slightly stouter spines.

The other kinds of scopulae occasionally found on both layers differ mainly in length from the one described above. They are about two or three times as long as the former scopulae, measuring 340μ long in shaft and 80μ long in dermal branch.

Transitional scopular forms, connecting the smallest one to the largest, here described, are quite frequent. Scopulae with fewer than four branches are not found in *intermedia.*

Uncinates, varying in length and thickness, quite frequently occur close to the dictyonal honeycomb. They are arranged perpendicularly to the dermal and mostly obliquely to the gastral surfaces and usually reach only to the inner two-thirds of the whole thickness of the body wall. The outer half of the spicule, nearer the dermal surface, is always slightly thicker than the inner half, nearer the inner regions of the parenchyme. The inner half tapers quite gradually to the pointed end. The weak barbs around the shaft are not so numerous.

Of the spicules irregularly scattered throughout the parenchyme, I will first describe those simple hexactins that measure 140μ to 160μ in axial length and seem to play so important a part in the growth of the dictyonal network. Their rays are fairly stout, straight, gradually tapered, bluntly pointed, and irregularly covered with small, more or less numerous tubercles.

The peculiar oxyhexasters are scattered abundantly in the hypogastral regions and are not found in the parenchyme or in the dermal regions. They measure 24μ to 28μ in diameter and have stout principals 3μ broad near the base, being somewhat thicker toward the distal end, from which numerous outwardly curved terminals arise. These terminals vary in number from 10 to 13 on each principal and are very short, about half as long as the principals.

Much more peculiar and worthy of interest are the hexactins, hemihexactins, oxyhexasters, and onychasters, irregularly scattered in varying numbers through the parenchyme. They are subject to considerable variation; their shape and size vary in different regions of the same individual. They are frequently found in the same place intermixing with one another. Four kinds of intermediary parenchymalia, except the onychaster, are to be distinguished: Stout-rayed microxyhexactins, microhexactinic and microhemihexactinic forms, the rays of which show a tendency to bifurcation so that they pass into oxyhexasters.

The regular oxyhexasters with six equal main rays, which are nearly the same thickness as the terminals, form right angles with one another. They are terminally crowned with groups of 3 or 4 nearly straight branch rays of uniform thickness, shape, number, and degree of divergence. The main rays, measuring 8μ at the base, are generally short. The spicules usually have a diameter of not more than 80μ.

The microhexactins and hemihexactins have more or less the same features, measuring 80μ to 100μ in diameter. Their rays are strong

and broad at the base, measuring 8μ, attenuating gradually toward the pointed ends. The surface is faintly rough.

The more robust onychasters, measuring about 50μ to 70μ in diameter, are also found together with the spicules on the upper side, but more numerous in the subgastral or in the subdermal regions. All the rays are somewhat slender and inconspicuously roughened near the ends. The terminations of the branch rays bear a verticil of fine claws, usually four in number. These are perpendicular to the branch ray and slightly recurved.

Small onychasters are present in the parenchyme layer, intermixed sparsely with larger onychasters. They are more abundant in the subgastral regions. They measure 30μ to 40μ in diameter and have two or four widely diverged terminals, the surface of which is quite smooth.

In the compact, thickened regions of the sponge wall near the sieve plate, the dermal hexactins occur more densely than in other parts of the entire sponge body. The proximal ray of the hexactins is much longer, attaining a length of 680μ to 750μ, while the distal poplarlike ray is somewhat slenderer and shorter, measuring 160μ to 200μ in length. The tubercles of the proximal ray are very pronounced toward the end of the ray. In general, the distal poplarlike ray of the spicule is much broader and stouter, being much longer than that of the ordinal hexactins distributed in other regions of the sponge body. In the parenchyme of this region, the microscleres are rarely found; especially lacking are the hexactinic and hemihexactinic forms and the onychaster.

The diactinic gastralia are thickly accumulated and irregularly distributed, being many times as thick as the ordinary ones of the subgastral regions, and measuring 0.8 mm to 1.7 mm thick. (It is somewhat interesting to note that a dictyonal framework is not found in the parenchyme of this region.)

Uncinates, when they occur, are also found in fewer numbers. They penetrate vertically to the surface, nearly approaching the gastral surface.

The peculiar oxyhexasters occurring on the gastral membrane are practically absent, and when they do occur they are sparsely scattered.

The so-called latticelike plate of this species differs somewhat from that occurring in *Aphrocallistes beatrix* Gray in several particulars. The meshes are nearly circular, being 2.5 mm to 3.5 mm across; their beams are tolerably thick and composed of diactins, which are entirely similar to those occurring in the gastral membrane. Many previous authors, as Schmidt, Marshall, and Schulze, who discussed some points of distinction between the internal diaphragms and that of the terminal sieve plate in *Aphrocallistes beatrix* Gray, came virtually to the same conclusion regarding this point. In the present

specimen, the narrow-meshed terminal sieve plate is united all around to the thinner body wall and is not separated by several openings of new additional zooecial tubes, as in *Aphrocallistes bocagei* P. Wright.

APHROCALLISTES YATSUI, new species

PLATE 4, FIGURES 2, 3

A nearly complete specimen (holotype, U.S.N.M. No. 22108) of *A. yatsui* was collected from Station 4781 (near the western extremity of the Aleutian Islands at 482 fathoms). The body shows a somewhat dorsoventrally compressed, cuplike form, gradually narrowed toward the stalklike basal regions, and expanded toward the nearly truncated oscular edges. The surface of the sponge is very porous, owing to the great numbers of large and small afferent canals, the outer ends of which are generally rounded and vary in size up to 1 mm in diameter. Nearly all of them are large enough to be noted macroscopically. The surface has a very homogeneous appearance.

It is generally difficult to trace the distinction between a dermal surface and a gastral surface in this sponge. On the gastral surface the larger and smaller efferent canals make their appearance, arranged somewhat regularly and much more visible than on the dermal surface. The outer edges of the efferent canals are usually raised to a slight degree by the thickening of the gastral surface.

Spiculation.—The arrangement of the constituent beams of the dictyonal framework has a certain regularity. Beams directed radially to the surface of the sponge may be distinguished. Between these lie the connectives, which are frequently transverse, thus giving rise to rectangular meshes. The superficial ends of the radial beams form tapering spines of varying lengths, sometimes very short, frequently long, often slightly irregular, and as a rule thickly covered with microtubercles. The beams in general are sparsely covered with similar tubercles. Usually they are 80μ thick.

Slender, sharp, tuberculated spines generally project from the nodes of the skeletal reticulum, on the free surfaces and edges of the plate. Some of the very delicate connecting bars that extend between the adjoining skeletal plates give the impression of having arisen through the fusion of such spines.

The dermalia are exclusively hexactinic pinules, so far as those of the body proper is concerned. The pinular ray as a whole is nearly spindle shaped, 160μ to 200μ long and 30μ to 50μ broad in the middle, which is about the broadest part. In this part, the obliquely upwardly directed, conical spines are closely distributed. The rhachis is smooth for a short distance at the base, which is about 12μ thick; its conically pointed outer end forms the tip of the pinular ray. The remaining five rays are somewhat slender, and

gradually taper toward the conically or bluntly pointed end. They are beset with small, generally erect prickles, on the end. The proximal ray though occasionally nearly as long as, is usually much shorter than the paratangentials of the same spicule, measuring 100μ in length. The paratangentials usually measure 160μ in length and when subequal to the proximal ray the latter will be found to measure between 120μ and 140μ long.

The gastralia include both pentactinic and diactinic forms. The diactins in most regions are much the more abundant, and the pentactins are scarcely anywhere more numerous than the diactins. In the pentactins, the distal ray is not represented by a boss; the tangential rays measure 120μ to 230μ in length. They have blunt or rounded tubercles on the distal end and are quite straight and not curved inwardly. The proximal ray as a rule is longer than the tangentials, about 200μ to 300μ long, is of about the same thickness as the tangentials, and tapers evenly to a point above, where it is prominently roughened. Elsewhere it is smooth or has a few scattered, weak, minute prickles. Nearly all the rays taper evenly toward the end, which is blunt or rounded.

The diactins are stout, straight, varying in length from 200μ to 400μ, and gradually tapering toward the conically pointed ends. They are usually provided with two to eight defined swellings at the center, measuring 20μ in width, while the ray near the center measures 8μ in breadth. In some of the diactins, mostly those up to 450μ in length and 12μ broad, the distinct central knobs are not seen. These closely resemble those occurring commonly in other species of *Aphrocallistes*. The roughness of the surface is commonly much more pronounced at the distal ends and sparsely scattered on the central knobs and other parts. Occasionally variously developed, prominent microspines cover the entire surface.

The uncinates show the usual shape, vary considerably in size, extend radially or obliquely, and are usually immersed in the sponge wall without penetrating it.

The hexasters are of the discohexaster, tylohexaster, and hemidiscohexaster types, as well as of the stout peculiar oxyhexaster type. They are scantily or only fairly abundant, intermixed with one another. The discohexasters are most abundant in the parenchyme, being nearly spherical, with a diameter of 30μ to 40μ. Each principal, which is not very short, bears a bunch of two to four or more terminals, which are smooth-surfaced, slightly thickened toward the outer end, and capped by a minute disk, which is divided into two or three clawlike teeth directed backward.

Occasionally the hexactinic forms may be present in the parenchyme. In hexactinic forms the axial length may reach 70μ, showing an increase in diameter over the normal form. The rays

taper considerably toward the end, which is supplied with two or three backwardly diverging, slender, short claws. Beside these forms, there is a microdiscohexaster, nearly resembling that commonly occurring in the Acanthascinae and measuring 20μ in diameter. They are scattered in the gastralia as well as in the parenchyme, though much more sparsely in the latter. In parenchymal regions scattered large hexactins with slender rays are rather more numerous than in the subgastral regions. The axial length of the rays is 120μ to 200μ; breadth at base, 6μ. All the six rays in the same spicule in general are subequal, though in some cases the distal ray is somewhat shorter than the paratangential rays. Occasionally also the free proximal ray may be longer than the paratangentials. All the rays are gradually tapered to the sharply pointed end. The microtubercles may be slightly more pronounced on the distal ends than on any other, but in any case the differentiation is never carried out to any considerable degree.

The stout oxyhexasters are present in the subdermal regions in small numbers, being sparsely scattered. They measure mostly 75μ to 85μ in diameter and have remarkably thick, conic rays, measuring 8μ on the base near the center of the spicules. The rays are usually divided into two terminals. Occasionally they are not divided, the principal being prolonged into one terminal ray. They are nearly smooth over the entire surface.

Scopulae fall into only one class, having four or six distal rays, measuring 35μ to 60μ long, being cylindrical and covered with sparse and minute tubercles, and terminating in very small round enlargements. The shaft at its upper end has a definitely circumscribed enlargement on which the rays rest; tapering thence to the conically shaped point, above which it is sparsely roughened. Elsewhere it is nearly smooth. The shaft is 200μ to 250μ over all and 4μ thick just below the upper enlargement. Scopulae occur only on the dermal surface, penetrating obliquely or horizontally to the sponge wall, close and nearly parallel to the proximal rays of the pinularlike hexactins.

APHROCALLISTES ALEUTIANA, new species

Several small colonies and fragments of *A. aleutiana* were collected from Station 4780 (near the western extremity of the Aleutian Islands). They are all nearly macerated or washed out, and can not be described in any great detail.

Spiculation.—The dermalia are slender hexactins, with free distal rays 50μ to 60μ long, terminally sometimes thickened in a nearly circular pear-shaped manner. They are covered with short slender thorns, which diverge slightly obliquely, and are curved toward the end of the ray, showing a rounded or angularlike boss, which is 50μ

to 60μ long. The tangential rays are simple, straight, prominently tuberculous at the weakly blunt or conically pointed ends, and twice or four times as long as the distal ray, measuring 130μ to 200μ in length. The proximal unpaired ray is nearly similar in shape and generally much longer than the paratangentials.

The gastralia are stout, straight diactins with a more or less clearly defined swelling at the center, measuring 20μ in breadth. Their ends are conically pointed and are always covered more or less densely with small pointed tubercles. The spicule is usually very sparsely covered with such protuberances throughout its entire length. The length of these spicules varies considerably, from about 1.2 mm to 1.5 mm or more. Besides this diactin in the gastral layer, there are frequently pinularlike hexactins, which are nearly similar to those of the dermalia. The presence of the latter spicule, the hexactin, is quite distinctive of the members of *Aphrocallistes;* but *aleutiana* is seemingly more similar to *Hexactinella* than to *Aphrocallistes* in dermal and gastral spiculations.

The scopulae are numerous, are arranged horizontally to the surface, and are of two kinds. One is small, measuring 250μ to 300μ in length, and the other is larger, 400μ to 500μ long. In the larger type, the dermal branches usually number 4 or 5 and are uniformly bent outward in a club-shaped manner. The branches, which arise from a comparatively short thickening at the distal end of the shaft, measure 130μ to 150μ in length. They are nearly cylindrical, either of nearly uniform thickness throughout or basally slightly thin and terminally thickened in a knot-shaped manner at the distal end and uniformly and densely covered on the entire length with minute spines, directed obliquely backward. The shaft usually measures 400μ in length, becoming gradually tapered toward the conically pointed end. In a small one, the terminal branches usually number four, running nearly parallel toward the thickened club-shaped ends. They are covered with small, slender, oblique spines, which are directed backward, the spines on the distal knot-shaped thickening being slightly stouter. The shaft is generally simple, straight, 200μ to 250μ long, and gradually tapered toward the pointed end. It is rough at the end, but for the remainder of its length is entirely smooth. The chief characters aside from the one just described include the following: The distal thickening of the shaft is indistinct and the branches arising from the margin extend upward, being nearly parallel to each other, and uniformly thickened throughout toward the small club-shaped thickening.

Uncinates, varying in length and thickness, are found close to the dictyonal honeycomb. They are arranged horizontally or obliquely to the surface and usually penetrate the whole thickness of the body wall. The outer half of the spicule, nearer to the dermal surface, is

always much thicker than the inner half, nearer the gastral surface, which is quite gradually attenuated to a pointed end. The spines are projected first in horizontal transverse directions and then are bent backward.

Besides this distinct uncinate, there occasionally occurs a small uncinatelike spicule. It is usually 300μ long. The distal end is somewhat extended in a lobelike manner, measuring 25μ in breadth and is then gradually tapered toward the conically pointed end, which is 8μ in breadth. The surface is roughened by densely distributed microtubercles at the end of the spicule but elsewhere is quite sparsely roughened by microtubercles.

Of the spicules irregularly scattered throughout the parenchyme I have found only one kind of onychaster. It is 40μ to 80μ in diameter. From each short principal (6μ long as measured from the axial center) there arise two or three fairly thick, nearly straight, and strongly divergent terminals. The finely attenuated end of these bears a whorl of two or three fine backwardly arched minute claws. The surface of the terminals is sparsely covered all over with minute pointed microspines directed backward.

The chief distinguishing characters of this species are: (1) The uncinate is very robust in form, with large, short barbs; (2) the small uncinate is distributed irregularly and is rarely found in the dermal layer; (3) microscleres usually consist of one kind of onychaster, measuring 40μ to 80μ in diameter and rarely of a normal oxyhexaster.

The present species is somewhat allied to the members of the *Aphrocallistes* group but differs from them by the existence of the gastral hexactinic pinules together with the diactins.

INDETERMINABLE APHROCALLISTES

There is in the collection a fragmentary specimen, probably referable to *Aphrocallistes*. Since it is badly macerated, it can not be more fully determined. It was taken at Station 5090 (entrance to Uraga Strait between Jôgashima and Okinosé), and consisted of small fragments of a thin-walled skeletal tube.

Tribe LYSSACINOSA Ijima, 1927

Family LEUCOPSACASIDAE Ijima, 1903

Genus CHAUNOPLECTELLA Ijima, 1903

CHAUNOPLECTELLA SPINIFERA Ijima

Chaunoplectella spinifera IJIMA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 18, art. 1, pp. 71–77, pl. 5, figs. 14–17; pl. 6, figs. 1–8, 1903.

I have discovered in the collection a fairly large colony that is unfortunately incomplete, lacking parts of the lateral wall. Though

it differs in some respects from the type, I am strongly inclined to refer it to *C. spinifera*. It comes from Sagami Bay (Station 5085), where it was taken at a depth of 622 fathoms.

Although the sponge has come to maturity, I have, unfortunately, not found the spines on the paratangentials of the dermal oxypentactins, which constitute a characteristic feature of the species. As to the forms or varieties of discohexasters, I have also met with nearly the same forms as those occurring in the type specimens, but their dimensions seem to be different from those of the latter. Of the discohexasters, the commonest form, corresponding in outer appearance to that which Ijima (loc. cit. p. 76) called the first variety in the typical species, has somewhat larger dimensions, attaining 108μ in diameter. The second variety (loc cit. p. 75) in the typical species often appears and varies from 120μ to 180μ in diameter. In outer appearance it is to be considered as represented by two forms. One has a widely expanding bunch of terminals and is 160μ to 180μ in diameter, while the other forms somewhat slender terminals, grouped separately, narrow at the middle and outwardly expanding into tufts, usually measuring 140μ in diameter. The largest variety, which Ijima called form *c* in the type specimens, appears occasionally. Its diameter falls short of the 230μ of the type specimens, measuring only 210μ in the present specimen. The fourth variety of discohexaster seems to be wanting here, but perhaps it is to be considered as represented by the much more delicate form that I have just mentioned above in the case of the second variety. The discohexasters thus far indicated have specific features somewhat different from those of the type specimens. I identify the present specimen as *Chaunoplectella spinifera*, regarding the spicular differences to be a matter of individual variation.

Family EUPLECTELLIDAE (Gray) Ijima, 1903

Subfamily EUPLECTELLINAE Ijima, 1903

Genus EUPLECTELLA Ijima, 1903

EUPLECTELLA OWENI Kerklots and Marshall

Euplectella M. J. S. SCHULTZE, Ein Beitrag zur Naturgeschichte der Spongien, Bonn, p. 39, 1860

Euplectella oweni KERKLOTS and MARSHALL, Arch. Néerland. Sci. Exact. et Nat., vol. 3, p. 435, 1868.—MARSHALL, Zeit. Wiss Zool., vol. 25, suppl., p 189, figs. in pls., 1875; vol. 27, p. 128, 1876.—F. E. SCHULZE, Abh. kön. preuss. Akad. Wiss. Berlin, 1886, p. 38; Rep. Voy. *Challenger*, vol. 21, p 78, pl. 6, figs. 1, 2, 1887; Abh. kön. preuss. Akad. Wiss. Berlin, 1895, pp 29, 48 — IJIMA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 15, p. 202, pl 6, figs. 1–10, 1901.

There are five specimens of *E. oweni* in the collection, which were taken as indicated in Table 16.

TABLE 16.—*Record of specimens of* Euplectella oweni

Specimen	Collected at—	Number and description
A	Station 4876, eastern channel of Korea Strait, vicinity of Oki Islands, Japan Sea, 59 fathoms.	1, small, lacking parts of sieve-plate and lower parts.
B (1, 2, and 3)	Station 4878, eastern channel of Korea Strait, vicinity of Oki Islands, 59 fathoms.	3, large, complete.
C	Station 4948, east of Hiuga Province, 65 fathoms	1, small, complete.

Specimen A is the smallest one in the collection. It measures 113 mm in length, excluding sieve plate,[1] and the broadest part [2] (ledges included) is 24 mm in diameter. The compressed lower end of body measures 13 mm in diameter, and the part immediately below the sieve plate is about 8.5 mm in diameter. This specimen is rather delicate in form, with thin walls and inconspicuous parietal ledges, which frequently form irregular ribbonlike masses or protuberances. It somewhat differs from typical *E. oweni* in the presence of a lophocome, in the number of transverse and longitudinal beams relative to the size of entire stock, and in having weakly developed parietal ledges. Nevertheless, I think it advisable to identify this form with the present species.

First, the lophocome (though somewhat different from that of *E. marshalli* in its dimensions) scarcely deserves to be considered a character of such systematic significance as to warrant establishing a new name. The lophocome may possibly exist in *E. oweni*, even though it has not yet been described in the hitherto known specimens.

Secondly, the proportional number of transverse and longitudinal beams is not a constant character in these sponges, especially in young specimens, thus also losing its importance as a distinctive specific character. The numbers of transverse and longitudinal beams in this specimen are as follows: Circular beams, 52; longitudinal beams at upper end, 25; longitudinal beams at middle, 34; longitudinal beams at lower end, 19.

The above-mentioned characters seem to indicate some relationship with *E. marshalli*. The lophocome occurs quite rarely and singly. The diameter is 61μ. The principal rays are 4μ to 6μ in length. The terminals are 22μ to 24μ long and exceedingly fine. They are pointed at the outer end and arise close together from all parts of the outer disk surface. The peripherally situated terminals in each tuft are slightly but distinctly flaring, so that the tuft may be said to be campanulate.

[1] The sieve plate is damaged and therefore is excluded in measuring the total length of the body.

[2] Breadth measured after restoring compressed body wall to a cylindrical form.

The dermal swordlike hexactin is somewhat larger than that in the typical species but is smaller than those of the specimens from other stations. The length of the hilt ray is 120μ to 160μ. The blade ray is generally more than three times as long, up to 550μ. Guard rays are somewhat shorter than the hilt ray, measuring 88μ to 145μ in length.

Specimens B (1, 2, and 3) are beautifully preserved. Measurements and numbers of transverse and longitudinal beams are given in Table 17.

TABLE 17.—*Measurements and numbers of transverse and longitudinal beams of 3 specimens (B, 1, 2, and 3) of* Euplectella oweni

Specimen (B)	Body length [1]	Diameter of sieve plate	Body diameter		Diameter immediately below sieve plate	Number of beams			
			At broadest part [2]	At compressed lower end		Circular	Longitudinal at upper end	Longitudinal at middle	Longitudinal at lower end
	Mm	*Mm*	*Mm*	*Mm*	*Mm*				
1	220	29	36	21	34	40	24	27	19
2	210	22	40	20	20	46	23	33	24
3	247	32	45	28	35	40	22	28	23

[1] Exclusive of basal tuft. [2] Ledges included.

In specimen B, 1, the diameter of the parietal pores is large, measuring 1.5 mm. The parietal ledges are prominently developed, being 5 mm high. The broadest part of the body is usually situated far below the middle of the entire stock. The wall of the body is thick, attaining 4 mm in the thickest part of the entire stock (excluding the height of parietal ledges).

Spiculation.—It is a prominent fact that the blade ray of the dermal hexactin and the distal ray of the gastral pentactin are very long, compared with those of the specimens from Stations 4948 and 4876. This character seems to indicate some relation to the thickness of the sponge body. The dermal hexactin has a very long blade ray, measuring from 0.8 mm to 2.1 mm in length, while the hilt ray and the guard ray are comparatively short, measuring 110μ to 187μ in length.

I distinguish two forms of floricome, which I shall designate with the letters *a* and *b*. They seem to represent different quantitative proportions and to show certain differences in the manner of distribution within the sponge. Form *a*, the larger floricome, occurs commonly and measures 80μ to 100μ in diameter. It has 6 to 9 terminals (mostly 7) provided with 5 or 6 marginal teeth on the terminal plate. It is abundant, both subdermally and at the apex of the

dermal hilt rays. Form *b* is smaller than form *a*, measuring 68μ to 80μ in diameter. The number of terminals in a perianth varies from 9 to 12. The marginal teeth of the terminal plate are 3 or 4 in number and seem to occur frequently among the parenchymalia or subgastralia of the basal parts of the entire stock.

Oxyhexasters occur abundantly both in the subdermal and subgastral layers, being more numerous within the former layer, and least numerous in the middle parts of the parenchyme layer. Each principal ray usually bears four or five, sometimes only two, diverging terminals. The principals and terminals of the oxyhexaster of *E. oweni* are somewhat slenderer than in either *E. imperialis* or *E. marshalli*, but observation of the specimens, which may be referable to *E. oweni* in this collection, shows that the principals are frequently thick or that they occasionally have small knoblike swellings. In general, the principals that are provided with four or five terminals seem thicker than those beset with only two or three terminals.

The lophocome is probably absent.

The thin and rather short diactins do not exist in the strands of the comitalia which are provided with four tubercles at the center.

The oscularia consist mainly of the common diactins, with either two oppositely or four cruciately disposed central knobs. Frequently they are intermingled with many more pentactins, tetractins, and stauractins. Generally speaking the diactins are commonly located near the edge of the oscular membrane, and the other forms stand outside or in among them in mode of occurrence. The state of the oscularia mentioned above nearly resembles that occurring in *E. marshalli.*

The sieve plate shows parenchymalia consisting mainly of tetractins and diactins. The latter seem to occur more abundantly among the parenchymalia than do the former. Frequently diactins, which are provided with one to four short tubercles at the center, occur among the parenchymalia.

The small and large gastral pentactins are thinly beset with small prickles near their distal ends. Paratangential rays measure 100μ to 160μ long and 6μ to 8μ thick near the center. The distal ray measures 440μ to 528μ in length. Besides these pentactins, large triradiates and quadriradiates frequently occur. These are also tuberculated at the ends of the rays. The former have a smooth, straight basal ray, ending in a small, distinctly tuberculated protuberance, measuring about 715μ long and 22μ thick at the center. Paired rays are 45μ long, strongly diverging, slightly curved inward, and also tuberculated at the ends.

The basalia have a very broad, miter-shaped anchorhead, measuring 72μ across from tip to tip of opposed teeth. The latter are weakly

developed, measuring 24μ to 28μ in length, and are four, sometimes six, in number. They differ somewhat from those of the other specimens in having a strongly rounded apex at the head; not pointed as a gothic arch as in the other specimens from same locality.

In specimen B, 2, the diameter of the parietal pore is usually 1 mm and seems not to exceed this size. The parietal ledges are prominently developed, frequently measuring 5 mm in height, especially those of the oscular margin close to the outer margin of the sieve plate, which approach 6 mm in height. The wall of the body is also thick, as in specimen B, 1, measuring 4 mm at the middle of the body, and becoming gradually thinner toward the upper and lower ends, measuring 2.3 mm.

Spiculation.—The hexactin of the dermalia is not so large as that of specimen B, 1, usually having the blade ray 830μ to 1,370μ long. The paratangential rays are proportionally very short, measuring 66μ to 121μ in length.

Form *b* of the floricome in specimen B, 1, is probably not present in this specimen. The basalia do not differ from those of the type specimens, except in being slightly robuster and in having a perceptibly thicker shaft. The anchor teeth, of which there are five to eight in each head (usually six or seven) are strong and about 60μ long. The distance from tip to tip of any two oppositely situated anchor teeth is 80μ to 88μ. The shaft is 24μ thick close to its origin from the head.

Specimen B, 3, is the smallest specimen obtained from the same location. It does not have such prominent parietal ledges as specimens B, 1 and 2. They measure 2 to 3 mm in height, and have sharp edges.

Spiculation.—Among the basalia, there is occasionally found a much smaller form of anchor-toothed spicule than in the typical form. The apex of its head is rather pointed as in a Gothic arch. The anchor teeth vary in length from 12μ to 24μ, and their numbers are constantly 4. The distance from tip to tip of any two opposed anchor teeth is 32μ to 56μ. The shaft close to the head is 8μ to 12μ thick. The spines on the shaft are not so conspicuous as those of the typical form and become more degenerate in number and length. Especially in the smallest one (basalia?), the spines are very short and are projected at wide intervals. These forms seem to be intermediate and probably grade over into the common anchor-toothed basalia and the pentactin basalia of these varieties.

An abnormality, like that occurring in the specimen from station 4948, is shown by three short tubercular spines projected sideways

from one of the anchor teeth near the apex of the head and another smaller protuberance near the end of a certain spine.

Specimen C is beautifully preserved, and its sponge body is nearly straight, phalluslike, and quite similar to the outer configuration of various specimens obtained from the southern part of Japan (especially to the specimen photographed on Plate 6, figure 1, of Ijima's Contribution I).

Parietal ledges are present but not so prominently developed. They run irregularly in places, and may approach 1 mm in height. Their free edge is fairly even, frequently being either blunt or sharp. The numbers of beams are as follows: Circular, 39; longitudinal at upper end, 31; longitudinal at middle, 28; longitudinal at lower end, 23.

Spiculation.—The oxea of the oscular margin are prominent, being usually slightly curved compass-needlelike spicules with two very weak oppositely placed tubercles at their center and sharply pointed at both ends. They occur in tufts or projecting singly from the dermal surface of the oscular margin and with the inner one-third to one-fourth of their length embedded in the oscular margin. They measure about 715μ to 780μ long and 8μ thick at their center.

The oxyhexaster is represented in greater numbers, as compared with the other specimens. It is especially abundant in the parenchyme, differing from the specimens from Station 4878, which have fewer oxyhexasters among the parencyhmalia than in the subdermalia and subgastralia. The same abnormality of the basalia occurring in the specimen from Station 4878 is also found in this specimen.

Family ROSSELLIDAE (F. E. Schulze) Ijima, 1903

Subfamily ROSSELLINAE F. E. Schulze, 1897

Genus CRATEROMORPHA J. E. Gray, 1872

CRATEROMORPHA MEYERI RUGOSA Ijima

Crateromorpha meyeri var. *rugosa* IJIMA, Annot. Zool. Japon., vol. 2, p. 49, 1898.

Crateromorpha meyeri rugosa IJIMA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 18, art. 7, pp. 71–74, pl. 4, figs. 10, 11, pl. 5, figs. 14, 15, 1904.

Two large specimens of *C. m. rugosa* were trawled up from a depth of 103 fathoms off Kagoshima Gulf (Station 4936). Both are badly macerated. One, a large fragment, is probably all the body proper of a large sponge, and the other is a nearly complete colony with a distinct large stalk, which during preservation was broken from the body. The stalk expands somewhat abruptly

at its upper end, is laterally compressed, and measures 22 mm by 15 mm at the middle, and is nearly as long as the body, 75 mm. It is compact looking throughout, being entirely covered by a dense coating of dermal and hypodermal spicules, which seem to have fallen from the Sagami Sea specimens preserved in the University of Tokyo. Internally it is traversed by a system of anastomosing excurrent canals. The conspicuous features of this subspecies mentioned by Ijima I have found also in these specimens. They show the irregularities of the external surface, which result from a pronounced thickening of the wall into protuberances in the lower part of the body, and occasionally numerous wrinklelike ridges in the general superior surface. But the agreement does not extend into the spiculation, since these specimens lack hexactins among the parenchymalia. In the first specimen, the breadth of the paratangential rays of the hypodermal pentactins is usually 50μ to 60μ at the base. They occasionally attain a thickness of 140μ. In most of the oxyhexasters, the ends of the terminals are somewhat curved inward at the tip, and I have observed this feature in the preparations from the Sagami Sea specimens. (I have occasionally found the onychasterlike hexaster in the preparations of the latter. I consider the onychasterlike hexaster to be a variation of the oxyhexaster with terminals curved at their ends because I have found a complete series of intergrading forms from one to the other.)

A thorough examination of slide preparations revealed a single case of a smaller microdiscohexaster, which is nearly like that of the common form of this spicule included in the tissues of other rossellids. The occurrence of this solitary microdiscohexaster in the slide preparations I believe is due to the contamination of the sponges either in the dredge or by other species that may have been placed in the same bottle at the time of collection. I have observed the presence of this spicule with the same size and shape in preparations of *C. meyeri* from the Sagami Sea, in the tissues of the basal region of the entire stock.

The second specimen that I refer to this species has essentially the same spiculation but with some points of deviation. Few of the terminals of the oxyhexaster show a curved end. This, however, I consider to be due to individual variation. The hypodermal pentactins are fewer in number and distributed sparsely and irregularly on the superior region of the entire stock. But among the dermalia of the stalk region, there are numerous short and robust-rayed spicules irregularly oriented. The paratangentials usually measure

but do not exceed 20μ to 200μ in length, and the proximal ray is 100μ to 120μ long.

CRATEROMORPHA CORRUGATA Ijima

Crateromorpha corrugata IJIMA, Annot. Zool. Japon., vol. 2, p. 49, 1898; Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 18, art. 7, pp. 78–86, pl. 6, figs. 1–8, 1904.

A small fragment of *C. corrugata* was collected from a depth of 131 fathoms at the entrance to Enoura, Suruga Gulf (Station 5069). The peculiar structure described by Ijima for *Scyphidium longispina* can be plainly seen in the present specimen. It also has very delicate filaments, arranged irregularly, in brushlike bunches.

Subfamily LANUGINELLINAE F. E. Schulze, 1897

Genus LANUGINELLA O. Schmidt, 1870

LANUGINELLA PUPA O. Schmidt

PLATE 5, FIGURE 2

Lanuginella pupa SCHMIDT, Grundzüge einer Spongien-Fauna des atlantischen Gebietes, p. 13, pl. 2, figs. 1, 3, 1870.—KENT, Monthly Micr. Journ., vol. 4, p. 247, pl. 65, figs. 1–6, 1870.—SCHULZE, Abh. kön. preuss. Akad. Wiss. Berlin, 1886, p. 47; Rep. Voy. *Challenger*, vol. 21, p. 130, pl. 53, figs 3–5, 1887; Sitz-ber. kön. preuss. Akad., vol. 26, p. 548, 1897.—IJIMA, Zool. Jap., vol. 2, p. 44, 1898; Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 18, art. 7, pp. 3–16, pl. 1, figs. 1–13, 1904.

There is a single specimen in the collection that may be identified as *L. pupa*. It was collected from a depth of 153 fathoms in Kagoshima Gulf (Station 4934), and seems to be the largest of the species hitherto recorded. It is cup shaped in form, 51 mm in height, and 35 mm in breadth at the widest part of the entire stock. It has also a short stalklike basal region measuring 8 mm in breadth at the middle. The dermal surface is quite smooth and not covered by a veil, as in the Sagami Sea specimens recorded by Ijima.

Spiculation.—Toward the stalklike base of specimens from the Sagami Sea the hypodermal lattice becomes unnoticeable. In the present specimen it is irregularly distributed, and has somewhat stronger-rayed pentactins with a shorter proximal ray. The pentactins of this specimen do not protrude through the dermal layer, so that the surface of their paratangentials is quite smooth. Occasionally there occur in the hypodermalia stronger and larger diactins, which measure 3.5 mm long and 100μ thick at the middle. In the stalklike basal region of the sponge they attain a length of about 5 mm.

The parenchymal oxyhexactins supporting the skeleton of the sponge may attain larger dimensions; the axial length frequently

measures 3 mm; and the thickness of the rays reaches 60μ near the central node.

As described by Ijima, the discohexaster shows considerable variations in both size and appearance in the same specimen. This condition is also found in the present specimen. In it I have discovered three forms of discohexasters, which are seen in the Tokyo University Faculty of Science specimen No. 436 of this species, which was taken outside of Okinosé in the Sagami Sea. The largest one, which measures 80μ in diameter, has three terminals, similarly thickened throughout; the intermediate one, which measures 60μ in diameter, is provided with four to five terminals; while the smallest one, 45μ in diameter, has more numerous delicate terminals, nearly resembling the so-called microdiscohexasters of certain other rossellids in appearance. In general, the number of terminals varies with different sizes of rosette, the smaller the rosette the fewer the terminals are in number.

Identical oxyhexactins, as well as canalaria and parenchymalia, occur in great abundance.

The strongiloplumicome of the present specimen usually measures 50μ in diameter and occurs abundantly in the subgastral region, as well as in the choanosome.

Genus HYALASCUS Ijima, 1896

HYALASCUS ATTENUATUS, new species

Figure 7; Plate 6, Figure 5

This new species is represented by two specimens. In specimen A (holotype, U.S.N.M. No. 22044), the body shows a vaselike, or somewhat barrellike, appearance. The height is 48 mm and the breadth 45 mm near the basal region (the attachment base is torn off, so that it can not be measured), and 40 mm above just under the oscular edge. The wall is moderately thick, 3 mm to 4 mm in the middle of the entire stock, and becomes gradually thinner toward the oscular margin. The osculum is comparatively large and circular, measuring 30 mm in diameter. The diactinic prostalia are confined to the oscular edge and to the superior regions of the entire stock. The marginalia generally project straight upward to a length of 5 mm to 10 mm.

Table 18.—*Record of specimens of* Hyalascus attenuatus

Specimen	Collected at—	Number and description
A	Station 4790, near Bering Islands, Bering Sea, 64 fathoms	One, large, basal regions torn off.
B	Station 4804, SE. of Shimushir Island, Kuriles, 229 fathoms	One, small, complete.

Specimen B is barrellike in shape and measures only 30 mm in height, with a roundish osculum 10 mm in diameter. It was directly and firmly attached to stones with the basal surface. The wall is 2 mm thick at the base and gradually becomes thinner toward the oscular margin, which is 0.8 mm thick.

Spiculation.—The following description applies to the first and larger specimen (A), unless otherwise indicated:

The parenchymalia are all slender diactins of variable thickness, measuring 10μ to 30μ broad and 1 mm to 2 mm long. Both ends of

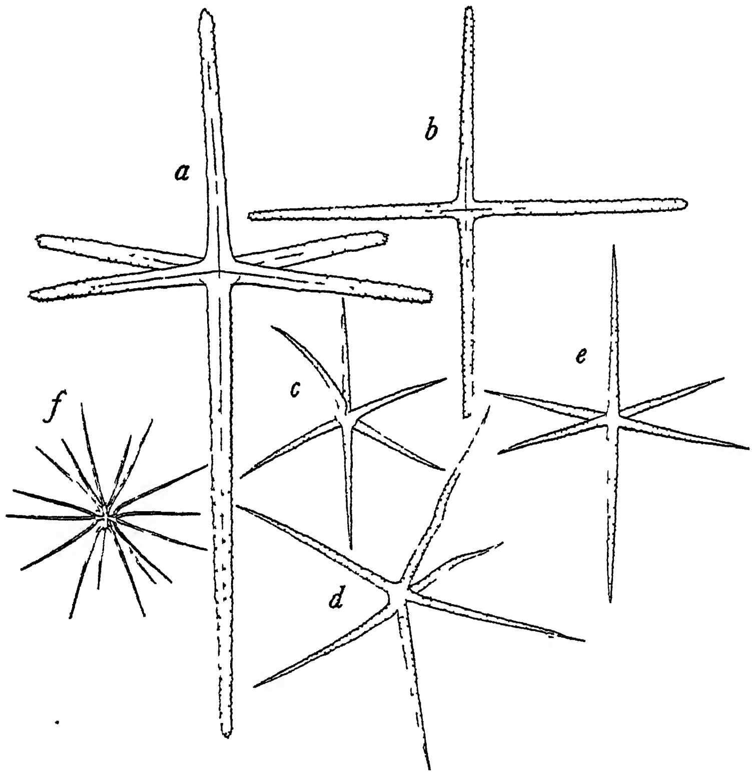


FIGURE 7.—*Hyalascus attenuatus*, new species. *a*, Gastral hexactin, × 175+; *b*, dermal stauractin, × 175+; *c*, hemihexactinic oxyhexaster, × 375; *d*, hemihexactinic oxyhexaster, × 375; *e*, hexactinic oxyhexaster, × 375; *f*, oxyhexaster × 375.

the diactins usually are conically pointed and beset with microtubercles on the surface. Sometimes each is spherically expanded, showing a moderately large knoblike swelling. The diactins occur either individually or are combined into long bundles. Besides this spicule, shorter and slenderer diactins, which are almost entirely smooth on the surface, frequently occur in the parenchyme. Very strong and large diactins are only occasionally found among the foregoing. They are more commonly present in the lower regions of

the sponge body. The diactins measure 3 mm long and 170μ broad at the center. They are of nearly the same breadth throughout, but taper suddenly near the sharply pointed ends, which have the surface roughened. Except the ends, the entire surface is quite smooth and completely covered with numerous striations. Single spicules occur irregularly.

The comitalia are only 12μ thick or sometimes less, showing as usual the same breadth for the greater part of their length.

The prostal marginalia are long diactins of variable sizes, projecting from the oscular edge and measuring 15 mm to 40 mm in length. They taper gradually toward the conically pointed ends, of which the distal one is smooth, while the proximal is rough. Furthermore, the prostal marginalia project from the surface of the superior regions of the entire stock. Most of the hypodermalia are moderately large oxypentactins with smooth, tapering rays, except at the end. The straight, unpaired proximal ray tapers strongly toward the sharply pointed and microtuberculated end and is 3 mm long. The paratangential rays are shorter or nearly the same length as the proximal ray, usually 1 mm to 1.5 mm. They are always either more or less curved or nearly straight, tapering gradually toward the conically pointed and sparsely tuberculated ends. These spicules may occur singly or grouped together. The paratangentials constitute the beams of the irregularly meshed hypodermal latticework.

The dermalia are mostly stauractins and pentactins, occasionally hexactins.

The pentactins are commonly supplied with a bosslike rudiment of the distal sixth ray. The paratangentials measure 80μ to 100μ in length (measured from the center) and 8μ in thickness at the base. The proximal rays are in general nearly as long as, or longer than, the paratangentials, measuring 100μ to 200μ. They taper perceptibly from the base toward the conically pointed end. The surface is beset throughout with microspines, which grow considerably weaker and thinner toward the base of rays and central node. In the stauractins (fig. 7, *b*) the bosslike rudiment is usually not present. The axial rays are 190μ to 240μ in length and roughened all over. The microspines on the surface are more pronounced on the conically pointed ends. In the hexactinic form, the proximally directed ray is not so long as in the gastral hexactins, and is nearly as long as the paratangentials of the same spicule.

The gastralia (fig. 7, *a*) are all rough hexactins in which the free proximal ray is usually much longer than the other rays. In length the paratangentials measure 140μ to 160μ. The distal ray is frequently shorter than, though occasionally as long as, the paratangentials. The proximal ray is 210μ to 280μ long and 12μ broad at base

of rays. All the rays taper gradually or strongly toward the sharply or conically pointed ends. Except at the base of the rays and on the central node, both of which parts are usually smooth or occasionally thinly microtuberculated, the surface of the rays is beset with numerous microspines similar to those on the dermalia.

Oxyhexasters, represented by normal, hemihexactinic, and somewhat less frequently by hexactinic, forms, are numerous in the choanosome and in the ectosome, as well as in the endosome. Normally developed oxyhexasters (fig. 7, *f*) are present frequently in the ectosome and in the choanosome. In them the center is swollen to a globular node, and the principals are exceedingly short or frequently almost obsolete. Two or three slender terminals, which are about half as broad as the principals, are attached to each principal. They are apt to be broken off near the base, as the fragments are found in abundance in the soft parts. In diameter, or axial length, the normal oxyhexasters measure 120μ to 140μ. The hexactinic forms (fig. 7, *e*) (axial length 160μ) are rarely found and are for the most part appreciably larger than those of the hemihexactinic form. The terminals are moderately strong, on the average, about 10μ thick at the base and slightly rough. In the hemihexactinic form (fig. 7, *c*, *d*), 1 to 3 of the 12 extremely short or almost entirely atrophied principals each bear two diverging terminals. These are fairly strong and nearly straight. All the terminals of the oxyhexasters mentioned above are rough on the surface, and in those of the endosome the roughness of surface usually becomes more pronounced toward the base of the terminals, distinctly on account of reverted microtubercles.

There is but one kind of microdiscohexaster. This is fairly common near the gastral surface. It is probably not altogether lacking among the parenchymalia. It is rather small and is spherical in shape, with a diameter of 40μ to 45μ. The six principals are fairly long, about 14μ in length; their outer ends are somewhat expanded, forming a disklike expansion. There are usually 14 terminals; frequently 10 to each principal. The terminal disks are rather small.

As regards the spiculation of the smaller specimen (B) herein provisionally referred to *H. attenuatus:*

Here the paratangentials of the hypodermal pentactins attain a maximum length of 0.85 mm to 1.4 mm, while the proximal unpaired ray may be 1.7 mm long and 25μ broad. They are shorter and decidedly slenderer than in the larger specimen; and further the paratangential is nearly straight to the ends which have an entirely smooth surface.

Among the dermalia the pentactins occur infrequently and the hexactins very rarely, while they are fairly abundant in the larger specimen.

Oxyhexasters are represented by normal hemihexactinic and hexactinic forms. The first are abundant and exhibit a distinct knoblike center and very short principals.

The distinct parenchymal diactins which become very much attenuated toward both ends seem not to be represented in the smaller specimen. Instead are found large diactins, which measure 5 mm to 6 mm long and 85μ to 150μ broad.

The basidictyonal plate is not completely formed, being represented by large individual or compound stauractins with ends bifurcated or multifurcated, connecting with those of other approaching stauractins. The surface is nearly smooth, except near the ends, which have scattered microspines.

Genus AULOSACCUS Ijima, 1896

This genus was originally established by Ijima because it differs from *Scyphidium* and *Rossella* in having no pentactinic hypodermalia, though otherwise it shows great affinity to both genera. If certain species of *Aulosaccus* described by him were only provided with pentactinic hypodermalia, there would have been no hesitation in including it in *Scyphidium* at that time. But in the various specimens in the collection before me, I have always found a pentactinic hypodermalia. The spicule in question easily drops from the dermal surface of the sponge and is not observed in poorly preserved specimens. Although Ijima mentioned the absence of hypodermal pentactins as the most important character of the genus, I maintain that it may be regarded as distinct from the genera *Rossella* and *Scyphidium* in having the macrodiscohexaster as well as the hypodermal pentactin.

AULOSACCUS FISSURATUS, new species

FIGURE 8

Both of the complete specimens are very similar in appearance, being large and vaselike in shape, attached by a somewhat narrowed base, and having at the broad upper end a large circular osculum. The larger specimen, which I make the type of the species (U.S.N.M. No. 22114), is nearly 175 mm long and 100 mm broad at the broadest part. The circular osculum measures 80 mm in diameter.

TABLE 19.—*Record of specimens of* Aulosaccus fissuratus

Specimen	Collected at—	Number and description
A	Station 4769, Bowers Bank, Bering Sea, 244 fathoms	Several macerated fragments.
B	Station 4775, Bowers Bank, Bering Sea, 584 fathoms	One, large, complete
C	Station 4781, near western extremity of Aleutian Islands, 482 fathoms.	One, complete, about same size as Specimen B.

Spiculation.—The parenchymalia are mainly diactins, which are as usual of varied dimensions, ranging from filamentous comitalia to principalia of 5 mm or more in length and 10μ in thickness in the middle. The larger diactins are oftener found in the deeper

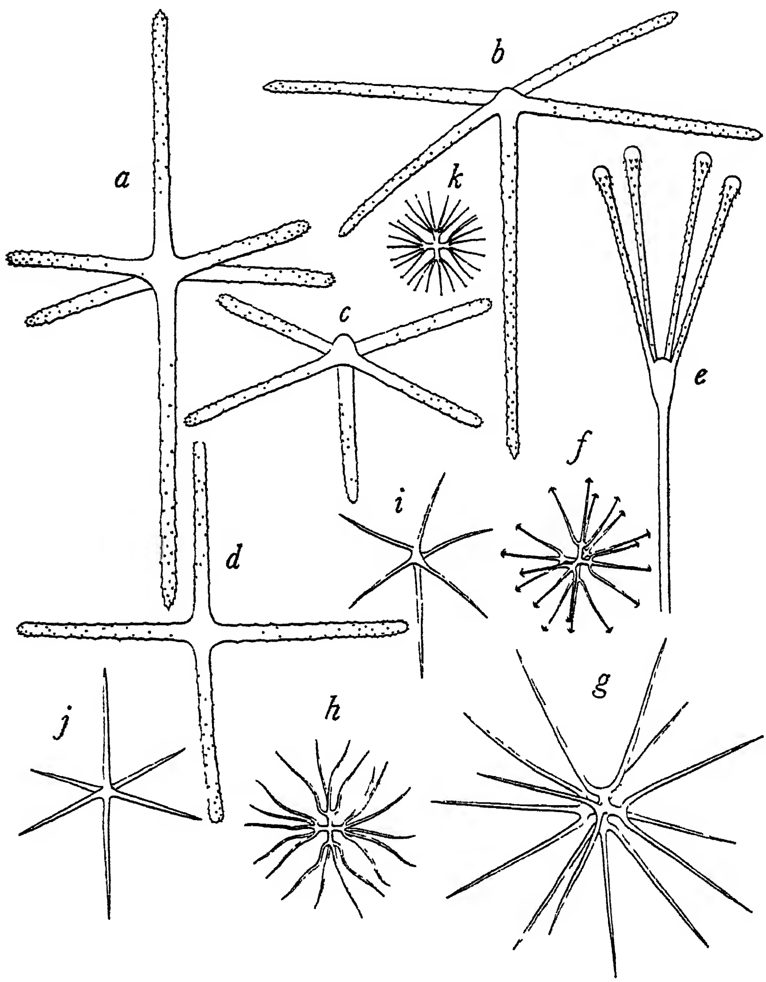


FIGURE 8.—*Aulosaccus fissuratus*, new species: *a*, Gastral hexactin, × 200; *b*, hypodermal oxypentactin, × 200; *c*, dermal pentactin, × 200; *d*, dermal stauractin. × 200; *e*, scopula, × 400; *f*, macrodiscohexaster, × 400; *g*, oxyhexaster, × 400; *h*, oxyhexaster, × 400; *i*, hemihexactinic oxyhexaster, × 200; *j*, hexactinic oxyhexaster, × 200; *k*, microdiscohexaster, × 400

parts of the body. They are bowlike and of nearly the same breadth throughout, with conically pointed and microtuberculated ends and without central swellings or knobs. The shorter and broader diactins, which are mostly isolated, are smooth at the center or, at most, with an annular swelling there; their ends are always roughened and rounded or conically pointed.

The hypodermalia are mainly large oxypentactins (fig. 8, *b*) with rather strong rays, among which the diactinic forms are intermixed. The former spicules vary somewhat in size. The paratangentials may be 180μ to 1,320μ or more long, and the straight unpaired proximal ray is always much longer than the paratangentials in the same spicule, measuring 490μ to 2,000μ in length. The rays at the base may attain a thickness of 70μ. The pointed ends of the rays usually are rough on the surface at a short distance from the end. Sometimes the surface is roughened all over, caused by their being densely covered with tiny microtubercles and lined with a few distinct straight striations. These pentactinic hypodermalia occur singly at the centers of the starlike texturings of the sponge surface. The radiating texture of the surface is formed by the paratangentials and by the slender diactins, described below, which help to support the dermal layer. The diactins, which occur either singly or together with the paratangentials of the oxypentactins forming the small bundles, are distinguished by two forms. One, less frequently found, is the shorter and broader diactin and is smooth at the center or, at most, with an annular swelling; its ends are always roughened and conically tapered or rounded to a point.

The dermalia are slightly rough pentactins (fig. 8, *c*), occasionally stauractins (fig. 8, *d*). The rays, measured from the center, average 150μ long and 12μ thick. The unpaired ray is somewhat shorter, measuring 75μ to 145μ in length. If they taper outward, it is only slightly. The ends are rounded or conically pointed. Not infrequently the pentactinic form, in which the unpaired ray is always directed proximad, shows an indication of the sixth distal ray in the form of a knob. The paratangential cross is usually straight and not convex. Seen from the surface, the delicate dermal latticework presents irregular meshes, though in places these tend to assume a regular quadrate arrangement. Near the oscular margin the latticework may be disturbed, forming a very irregular arrangement.

The gastralia are rough hexactins (fig. 8, *a*) with six long and more sharply pointed rays. The paratangential ray is 165μ to 220μ long; breadth at base, 20μ. All the six rays in the same spicule may occasionally be nearly uniform in length, though usually the distal ray is much shorter, measuring 120μ to 210μ, and the free proximal ray much longer, measuring 300μ to 340μ. The microtubercles are more pronounced on the distal parts of the six rays. They are sometimes entirely absent on the basal parts and on the central node of the rays. All the six rays are very gradually tapered distally and sharply pointed at the ends. Frequently the proximal ray (in the case of its ray measuring twice the length of the distal ray) is slightly curved laterally toward the proximal end.

Oxyhexasters of normal, hemihexactinic (fig. 8, *i*), and hexactinic (fig. 8, *j*) forms are found; the two latter most commonly in the choanosome and in the ectosome, as well as in the endosome. The normally developed oxyhexasters (fig. 8, *g*, *h*) are frequently met within the hypoderm and occasionally in the parenchyme layer. They measure 90μ to 150μ in diameter. From the slender and short principals arise the two slender terminals, moderately widely diverged. In the present species I have not seen the robuster larger oxyhexasters that occur in *A. albatrossi*, but I believe that some might have been discovered, had a more extensive search been made. Frequently, among the gastralia, the somewhat robuster oxyhexasters, mentioned above, are to be found. This oxyhexaster has the same dimensions, but it differs in having broader terminals and a distinctly microtuberculated surface. The hemihexactinic and hexactinic forms, being quite similar to those of *A. albatrossi*, are not described.

The macrodiscohexaster (fig. 8, *f*) is very much like that of *A. albatrossi*, except that it is perceptibly smaller in diameter. It averages 450μ in diameter and is provided with a round central sphere measuring 40μ to 45μ in diameter.

The microdiscohexaster (fig. 8, *k*) is of two forms. The larger one is rare in the dermal layer, while the smaller one is usually present in the choanosome and in the ectosome, as well as in the endosome. The former is essentially similar to the macrodiscohexaster known to occur in *A. mitsukurii*, but has a somewhat shorter diameter. It measures 75μ to 80μ and is fairly well supplied with terminals, which are generally straight and uniformily thick throughout their length. The terminal disks are small, and each is furnished with six or more minute marginal teeth.

The smaller microdiscohexaster measures 32μ in diameter. I have found this form on the whole sparsely distributed in the ectosome and in the endosome as well as in the choanosome, though exceedingly rare in the latter. The principals are slender and form a cross, measuring about 8μ in axial length. The terminals number six to eight and measure 12μ to 13μ in length. In the endosome, this microdiscohexaster usually attains a diameter of 36μ to 40μ. The terminals are also longer, measuring 16μ in length.

I have always found the structure of the basidictyonal plate of this species to be thick. The beams of this plate are entirely smooth and look quite different from those of *A. albatrossi*, and the meshes are much longer than in the latter.

Remarks.—The other smaller specimen is a vaselike form with a somewhat narrower inferior part of the body. The height and the

broadest part of the body are nearly the same as those of the type, but the osculum is somewhat oval in form, measuring 67 mm by 45 mm.

The species here described as new is unquestionably a very near relative of *A. schulzei* Ijima and *A. albatrossi*, new species. It can scarcely be said to differ from these species so far as the categorical forms of the spicular elements are concerned; but in the details of the characters I find in all individuals referred to it certain constant peculiarities that I think may be considered to be of sufficient specific value.

AULOSACCUS FISSURATUS SHIMUSHIRENSIS, new subspecies

A tolerably large fragment (holotype, U.S.N.M. No. 22046) was obtained from a depth of 229 fathoms southeast of Shimushir Island, Kuriles (Station 4803).

Spiculation.—The hypodermalia and hypogastralia are pentactins and diactins. The pentactinic forms appear frequently and are not so great in size. They are provided with paratangentials 130μ in length and with an unpaired proximal ray 680μ to 2,500μ long. The surface of the rays is sparsely microtuberculated all over. The rays taper slightly toward the rounded or conically pointed ends, the surface of which is not so prominently tubercled as that occurring in other members of the genus. The diactins are generally 20μ in breadth and are less than 180μ to 300μ in length. They taper very slightly toward both conically pointed ends; the surface is sparsely tubercled. The center of this spicule is frequently marked externally by a conspicuous swelling.

The parenchymalia are all slender diactins in loose, feltlike arrangement or grouped together into moderately thickened bundles. The principalia may attain a length of 9 mm or more and a breadth of 45μ at the middle; they taper gradually toward the rough and sharply pointed ends.

The dermalia are predominantly stauractins in which the atrophied fifth ray is frequently indicated by a gentle swelling on the distal side of the paratangential cross. The axial length measures 170μ to 200μ and is 8μ to 12μ thick at the base. For the greater part of their length they maintain a nearly uniform thickness. Besides this form, occasionally they are represented by pentactinic forms. The paratangential rays, as measured from the spicular center, are 75μ to 100μ long, and an unpaired proximal ray measures 92μ long and 5μ broad at the base. The thickness of all the rays is nearly the same, but decreases very slightly toward the rounded tips. Their

surface is entirely rough, the roughness being uniformly distributed on the entire surface.

The gastralia consist chiefly of rough hexactins. The paratangentials mostly measure 70μ long from the spicular center and 8μ thick at the base. The distal ray is nearly as long as, or somewhat longer than, the paratangential of the same spicule, while the proximal ray is usually longer, 105μ to 120μ in length. The rays taper perceptibly toward the conically pointed end; their entire surface is quite uniformly rough.

The hexaster, the oxyhexaster, and hemihexactinic forms are of frequent occurrence in all parts of the entire stock. Their axial length varies from 60μ to 80μ. The very thin and delicate terminals of the normal oxyhexaster are about 1μ thick at the base and diverge widely; the principals are distinct and thick. The hemihexactinic form is robuster, measuring 100μ in diameter; and the terminals are stronger and the roughness is more pronounced. It occurs mostly in the parenchyme, intermingled with the normal oxyhexaster and is more numerous than the latter.

The macrodiscohexaster shows a sunlike appearance, nearly like that occurring in other members of this genus. It varies in diameter from 680μ to 850μ. The axis of the central sphere measures 34μ.

The microdiscohexaster shows two kinds; the larger one is nearly similar to that occurring in *A. mitsukurii* Ijima and measures 80μ in diameter, with straight, strong terminals and with distinct principals 10μ long. The smaller one shows a delicate structure with a diameter of 40μ to 50μ, nearly the half of the former. It occurs chiefly in the dermal layer.

Remarks.—Our new subspecies closely resembles *A. fissuratus* in general spiculation, but differs from it in having a larger macrodiscohexaster and in the appearance of the microdiscohexaster.

AULOSACCUS ALBATROSSI, new species

FIGURE 9; PLATE 5, FIGURE 3

The larger, complete specimen A (holotype, U.S.N.M. No. 22111), upon which I base this description, is exquisitely vaselike, being broadest in the upper fourth of its length and gradually narrowing. The total length is 182 mm; greatest breadth, about 120 mm. The osculum is nearly circular, with a diameter of approximately 45 mm. The wall in the middle of the entire body is 12 mm thick; in the oscular margin, 2 mm. The greater part of the dermal skeleton has fallen off. Where it is preserved it shows a delicate dermal layer, of which the latticework is perceptible with the naked eye. The parenchymal mass, exposed to the eye on the ouside, presents as the re-

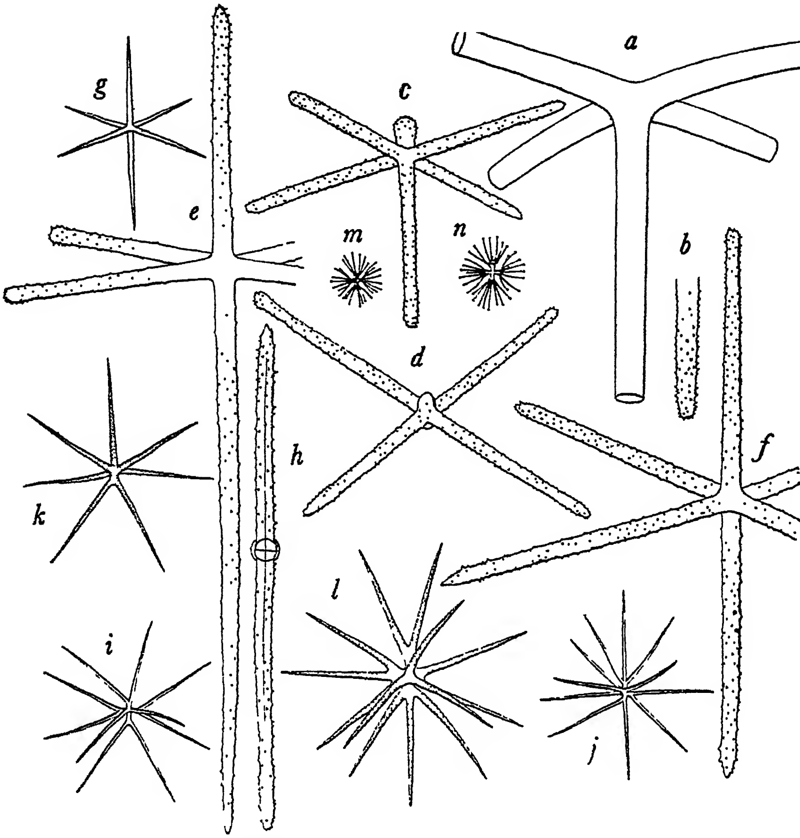


FIGURE 9.—*Aulosaccus albatrossi*, new species: *a*, Hypodermal pentactin, × 100; *b*, proximal part of hypodermal pentactin, × 100; *c*, dermal pentactin, × 200; *d*, dermal stauractin, × 200; *e*, gastral hexactin, × 200; *f*, gastral hexactin, × 200; *g*, small gastral hexactin, × 200; *h*, dermal diactin, × 200; *i*, small oxyhexaster, × 250; *j*, small oxyhexaster, × 320; *k*, hemihexactinic oxyhexaster, × 320; *l*, large oxyhexaster, × 320; *m*, microdiscohexaster, × 320; *n*, larger microdiscohexaster, × 320

sult of abrasion a curly appearance. The gastral surface is well preserved. It is lined all over with a continuous layer of the delicate endosomal skeleton.

TABLE 20.—*Record of specimens of* Aulosaccus albatrossi

Specimen	Collected at—	Number and description
A	Station 4797, near Petropavlovsk, 682 fathoms	One, large, complete.
B	do	One, small, represented by large pieces broken from superior region.

Spiculation.—The hypodermalia are pentactins (fig. 9, *a*, *b*) and diactins. The former show essentially the same character and ar-

rangement as in *A. fissuratus*. In general they occur singly and not in groups, the manner of arrangement being typically as described below. The starlike texture of the sponge surface is mainly formed by this pentactin, situated centrally with the diactins running along its paratangentials and entering with them into the support of the dermal layer. The pentactins are comparatively large, with rather strong rays. They are infrequently supplied with a bosslike rudiment of the distal ray, the end of which is strongly beset with sharply pointed microspines. The paratangentials may be 180μ to 1,045μ long and the unpaired proximal ray 500μ to 1,700μ long. The rays at the base may attain a thickness of 45μ. The conically pointed ends usually show a tuberculated surface. The diactins are generally 20μ to 30μ in breadth at the center and less than 3½ mm in length. They quite agree in appearance with the similarly sized hypogastralia, except for the fact that the spicular center is often, but not always, externally marked by an inconspicuous annular swelling.

The parenchymalia are all slenderer and longer diactins than those of the hypodermal and hypogastral layers. They are usually grouped together into curled, ill-defined bundles. The principalia may attain a length of 3 mm or more and a breadth of 30μ at the middle; they are of nearly the same breadth throughout and smooth on the surface except for the conical, tuberculated ends.

The dermalia are nearly the same as those of *A. fissuratus*. They are predominantly pentactins and occasionally stauractins. The rays of the pentactins (fig. 9, *c*), as measured from the spicular center, are 110μ to 165μ long and 8μ to 12μ broad at the base. Their surface is completely rough, the roughness being most pronounced near the conically pointed end. They are also commonly furnished with a bosslike rudiment of the distal ray. Stauractins (fig. 9, *d*) are only slightly rough all over. Their axial length is from 280μ to 450μ. The rays taper perceptibly toward the rounded or conically pointed tip and are almost uniformly thick; at the middle they are 8μ to 12μ thick. The meshes of the dermal latticework, which may be composed of pentactins and stauractins, are fairly regularly quadrate, averaging 143μ in length of sides. Seen under the microscope the dermal latticework is not regularly meshed throughout, especially on the dermal membrane of the oscular margin.

The gastralia are predominantly rough hexactins (fig. 9, *e*, *f*). The paratangentials usually measure 155μ to 190μ in length and 15μ to 18μ in thickness at the base. The distal ray is nearly as long as, or somewhat shorter than, the paratangential in the same spicule, while the proximal ray is generally much longer; it may be 330μ in length. Sometimes in the same spicule these rays are subequal, but often there is a high degree of variation in the length of the

distal or proximal ray. The rays are nearly uniformly broad through their length toward the conically pointed and microtuberculated end. These hexactins, being single or two or three in a group, also form a regular quadrate latticework, the length of which is nearly the same as those of the dermal layers or 110μ to 145μ. Besides these large hexactins, there occasionally occur small and delicate hexactins (fig. 9, *g*), which may be younger or not fully developed, with lengthened paratangentials, 80μ; distal ray, 75μ; and proximal ray, 90μ.

In this specimen I have occasionally found paratangentially disposed, diactinic dermalia (fig. 9, *h*) and diactinic gastralia. The manner of their occurrence in company with the stauractinic or pentactinic form in the ectosome and with the hexactins in the endosome leaves no doubt as to the legitimacy of considering them to be dermalia and gastralia. They seem to be linked to the hypodermalia and the hypogastralia by means of intermediate forms. Their presence in the species seems to be nearly constant.

Of the hexasters, the oxyhexaster (fig. 9, *i*, *j*, *k*) is of frequent occurrence in the endosome and the ectosome, as well as in the choanosome. The oxyhexaster exhibits the normal oxyhexaster as well as hemihexactinic and hexactinic forms. The normal oxyhexasters may be distinguished as of two kinds, the smaller one (fig. 9, *i*, *j*) is usually present in the ectosome and in the endosome of the superior region of the entire stock, while the larger one (fig. 9, *k'*) seems to occur in the parenchyme of the inferior basal regions. They differ in respect to both size and general appearance. The former is comparatively small and of a delicate appearance, with a diameter of 120μ to 130μ. From each exceedingly short and slender principal arise two or three thin, straight terminals, the surface of which is rather sparsely tuberculated. The latter oxyhexaster is larger, with much stronger terminals, measuring 76μ in length. The principals are usually fairly long and broad, 8μ at the base. The number of terminals to a principal is usually two or three. The diameter is 150μ to 160μ. Its entire surface is strongly tuberculated.

Hemihexactinic and hexactinic forms (fig. 9, *k*) are of frequent occurrence. In shape and size they quite agree with those of *A. schulzei*.

The macrodiscohexaster in this species is somewhat smaller than that of *A. schulzei*, usually measuring 250μ to 650μ in diameter, about half that of the latter species. The central sphere measures 35μ to 48μ in diameter. The terminals are delicate, slender, rodlike, and quite smooth-surfaced. The terminal disk is somewhat conically convex on the outer side. The margin shows a row of numerous small teeth. This spicule occurs usually in the hypoderm and in the dermal membrane, as well as occasionally in the parenchyme.

Microdiscohexasters (fig. 9, *m*, *n*) are of two kinds, namely, the larger, which usually occurs in the hypodermal region, and the smaller, which is found commonly everywhere, in the endosome, ectosome, and choanosome. The larger one measures 50μ to 56μ in diameter and is frequently somewhat better supplied with terminals (8 to 12) than the smaller. Terminals measure 16μ to 20μ long, are generally slightly curved inward distally, and are nearly uniformly thick throughout. The terminal disks are small and are furnished with minute marginal teeth. The principals are perceptibly broad and form a cross 10μ to 12μ in axial length. The common, smaller microdiscohexaster is comparatively small, measuring 32μ to 40μ in diameter. It is a very delicate form and usually occurs everywhere, except on the ectodermal region. In some places in the basal region of the entire stock it is more abundant than elsewhere. The principals are slender and form a cross 8μ to 10μ in axial length. Their outer end shows a disklike expansion from which slender terminals arise, 12μ to 16μ in length.

I have always found the basidictyonal plate to be fairly thick and very uneven. The irregularly contoured beams are sparsely microtubercled. The meshes are very small and roundish, oval, or irregular in shape.

AULOSACCUS SCHULZEI Ijima

Aulosaccus schulzei IJIMA, Zool. Anz., 1896. p. 252; Annot. Zool. Japon., vol. 2, p. 51. 1898; Journ. Sci. Coll. Imp. Univ. Tokyo, vol. 18, art. 7, pp. 110–117, pl. 8, figs. 26–28, pl. 9, figs. 1–12, 1904.

A single fairly large specimen of *A. schulzei* was collected southeast of Shimushir Island, Kuriles, at a depth of 229 fathoms (Station 4803). It is exquisitely vasiform, and 87 mm broad at the lower end. The greatest breadth is about 57 mm. Above the broadest part of the body the wall curves in more or less to terminate in the thin oscular margin, which in this specimen is much injured. The osculum is irregularly circular, with a diameter of approximately 34 mm. The thickness of the wall in the middle of the upper half of the sponge is 5 mm; in the middle of the lower half, about 18 mm. The greater part of the dermal skeleton has fallen off; the parenchymal mass exposed by abrasion presents a curly appearance. The gastral surface is quite well preserved, but most of the delicate endosomal skeleton has also fallen off.

The normal oxyhexaster, which is absent in the type specimens, appears intermingled with the hemihexactinic and hexactinic forms. It measures 135μ in diameter and its center is swollen to form a globular node. The terminals, generally two or occasionally three in number, arising from each principal are slender and rough. They seem to be rather brittle near the base, as their fragments are found in abundance in the soft parts.

The gastral hexactins, though somewhat shorter, are much more robust than those of the type specimens, measuring mostly 12μ to 15μ broad at the base. The roughness of the surface, caused by the existence of microspines, is also much more pronounced.

Remarks.—The present species somewhat resembles *A. fissuratus shimushirensis* from the same station in the essential characters of spiculation; but differs from it by the entire absence of the larger microdiscohexaster and by the structure of the normal oxyhexaster, which has the central knob well developed in the present species, while absent in the latter.

AULOSACCUS TUBERCULATUS, new species

FIGURE 10

This species is represented by three fragments (cotypes, U.S.N.M. No. 22122), which may belong to the upper portion of the same sponge (two fragments preserved in the same bottle are larger than

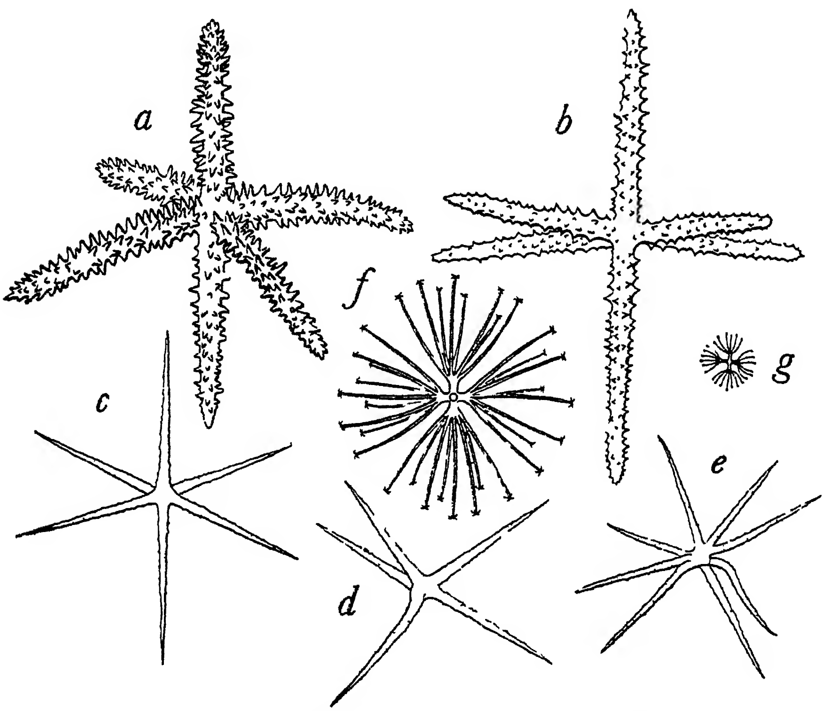


FIGURE 10.—*Aulosaccus tuberculatus*, new species *a*, Dermal hexactin, × 250; *b*, gastral hexactin, × 250; *c*, hexactinic form, × 500; *d*, hemihexactinic form, × 500; *e*, hemihexactinic form, × 500; *f*, macrodiscohexaster, × 500; *g*, microdiscohexaster, × 500

the third in another bottle). They were all obtained from a depth of 244 fathoms, off Bowers Bank, Bering Sea (Station 4769). The greater part of the dermal delicate latticework has fallen off, some

remaining near the marginal parts of the osculum. The incurrent apertures vary considerably in size, measuring 1 mm to 5 mm in diameter, and sparsely scattered with small and large ones intermingling. The excurrent ones are like the former in size and shape. The wall is about 9 mm thick in the middle, becoming gradually thinner toward the oscular margin, where it measures 1 mm.

Spiculation.—The parenchymalia are mainly slender diactins of widely varying sizes, reaching 7 mm in length and 20μ in thickness at the middle. They are sparsely distributed and are infrequently present singly or forming small bundles. The gradually tapering rays are provided with microspines at the end. The slenderer parenchymalia present no features worthy of special mention.

The hypodermalia and hypogastralia are predominantly diactins, which are much stronger and longer than those of the parenchyme, measuring 6 mm in length and 30μ to 50μ in thickness at the center. These spicules usually occur singly, rarely forming bundles, and are more densely distributed than in the parenchyme layer. They are nearly the same breadth throughout, with conically pointed, occasionally distinctly circular, expanded ends, the surface of which is usually microspined. Comitalia are slender diactins, smooth, but with roughened conically pointed ends. The length may reach 3 mm or more and the thickness at the middle 12μ.

The dermalia are rather thick-rayed pentactins, the paratangential rays of which are strongly arched on the dermal plane. Occasionally hexactins (fig. 10, *a*), stauractins, and tauractins are found. In the pentactins, the paratangential, as measured from the central point, is 90μ to 100μ long; the thickness at the base averages 12μ. The rays are very slightly narrowed outward; the tip is rounded or somewhat conically pointed. Their surface is thickly beset all over with well-developed, erect, and conical, or tubercular, prickles, which constitute one of the most striking characteristics of the species, as it does of *A. mitsukurii.* The hexactins and stauractins need no special mention. The quadrate meshes formed by apposed rays of the dermalia measure 100μ to 120μ in length of sides.

The gastralia are prominently stronger and larger hexactins (fig. 10, *b*) than those of the dermal layer, and are rarely pentactins. The rays are somewhat tapering toward the ends; the prickles on the surface are not so strongly and conspicuously developed as those of the dermalia. The proximal ray is the longest of the rays, measuring 120μ to 210μ in length while the distal ray measures 112μ to 128μ. The paratangentials are nearly straight and measure 108μ to 132μ; the thickness at the base averages 10μ. The quadrate meshes formed by the paratangentials of the gastralia usually measure 120μ in length of sides.

The pentactins are much like those in the dermal layer, but the prickles over their surface are not so prominently developed. They rarely occur in this layer. The prominent sixth ray knob is usually found in these spicules, though absent in the dermal pentactins.

The oxyhexaster consists of normally developed oxyhexaster, hemihexactinic (fig. 10, *d*, *e*), and hexactinic (fig. 10, *c*) forms. The former oxyhexasters are not so numerous. They occasionally occur in the ectosome and in the endosome, and far more rarely in the parenchyme. They measure 108μ in diameter. From each exceedingly short principal, there diverge usually two, thin, often slightly strong, obsoletely rough-surfaced, and nearly straight terminals. Frequently the last two forms are found throughout the sponge, being especially abundant in the choanosome. No special mention is made of the hemihexactinic and hexactinic forms. Generally speaking, the central nodes of these spicules are distinct, and the surface of all the rays is rough.

The macrodiscohexaster (fig. 10, *f*) is somewhat smaller than that of *A. mitsukurii*, is nearly spherical in shape, and measures 90μ in diameter. It is not so well supplied with terminals; these are very thin and generally not straight. No more than five terminals arise, not in a circle but promiscuously from the disklike expansion of each very short broad principal. The terminal disks are very small and are furnished with three or four sharply pointed claws. This macrodiscohexaster is found chiefly in the dermal and gastral layers, and frequently quite abundantly in the choanosome.

The microdiscohexaster (fig. 10, *g*) is small, only 28μ in diameter, and spherical in shape. I have found it fairly numerous in the gastral and dermal membranes, but in the parenchyme it is exceedingly rare.

AULOSACCUS SOLASTER, new species

FIGURE 11

This species is represented in the collection by a large fragment (holotype, U.S.N.M. No. 22109) that seems to be the superior part of an entire stock. It was obtained southeast of Shimushir Island, Kuriles, at a depth of 229 fathoms (Station 4804). The osculum may attain 140 mm in size. The body wall is very thick, measuring 30 mm at the inferior region, and becomes thinner toward the oscular margin. It has a yellowish-white color in alcohol.

Spiculation.—The parenchymalia are all slender diactins of variable thickness. Their ends are usually beset with microtubercles and are mostly conically rounded. The diactins occur either singly or combined into long threadlike bundles. In the latter case, they are curled strongly among the parenchymalia, commonly about 1.5 mm thick. These diactins are long, attaining a length of 4.25 mm to

6 mm or more, and are nearly uniformly broad throughout the entire length, measuring 8μ to 20μ at the center.

The hypodermalia and hypogastralia are mainly diactins; pentactins are not found. These hypogastral diactins are broader but shorter than those of the hypoderm. They measure 16μ to 40μ thick at the center and attain a length of 1.37 mm to 2 mm. Sometimes their spicular center shows a gentle annular swelling.

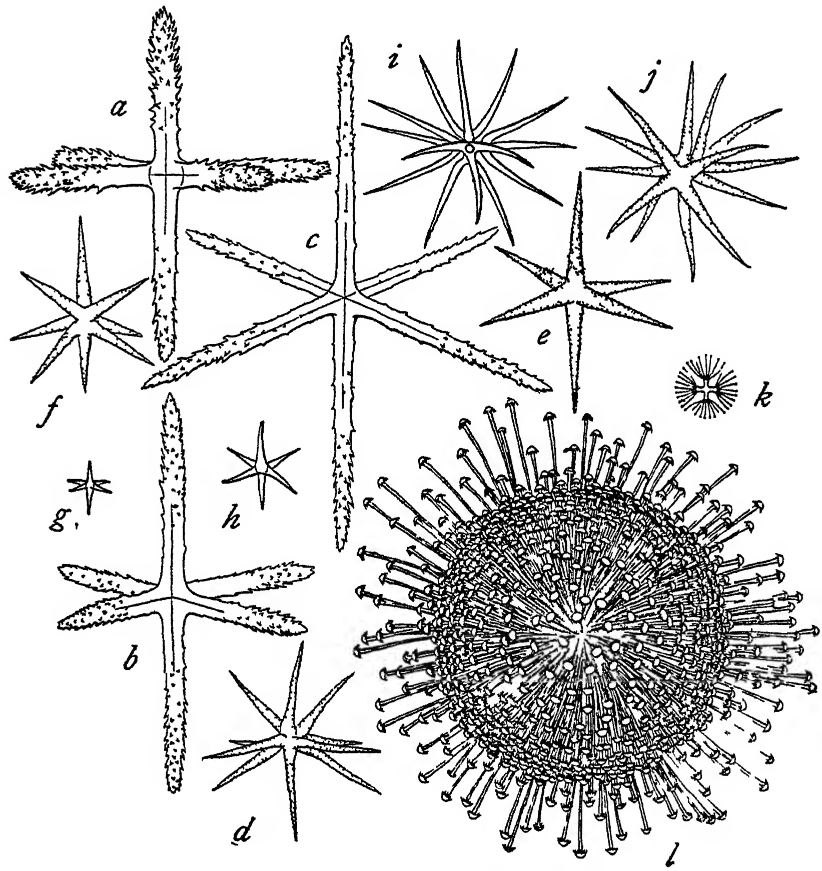


FIGURE 11.—*Aulosaccus solaster*, new species. *a*, *b*, Dermal hexactins; *c*, gastral hexactin; *d*, hemihexactinic form; *e*, hexactinic form; *f*, hemihexactinic form; *g*, *h*, small hexactinic form; *i*, *j*, oxyhexaster; *k*, microdiscohexaster; *l*, macrodiscohexaster. All × 225.

The dermalia are all hexactins (fig. 11, *a*, *b*) in which the proximal ray is always longer than any of the other rays. They are of two forms, one being occasionally intermingled with the others. In the first kind, the length of the paratangentials is 100μ to 132μ; distal ray is as long as the paratangentials or somewhat longer; length of proximal ray, 121μ to 154μ; breadth at base of rays, 20μ. The length of paratangentials in the smaller one is 68μ to 73μ; the distal ray is also as long as the paratangentials or somewhat longer; length of

proximal ray, 75μ to 80μ. All the rays taper very perceptibly toward the conically pointed ends. Their surface throughout is beset with conical, erect, or nearly erect microspines, which are sometimes absent on the base of the rays and on the central node. Both of these parts are smooth. The microspines on all rays are strongly directed toward their ends. The meshes of the latticework for the greater part appear quadrate, measuring 110μ to 143μ in length of sides.

The gastralia are also hexactins (fig. 11, *c*), of nearly the same shape as those of the dermal layer, but on the whole much larger. The length of the rays, as measured from the spicular center, is usually 155μ to 180μ. The six rays are nearly the same length, but often the distal ray is shorter than the others, measuring 120μ to 165μ in length. Except at the base of the rays and on the central node, both of which parts are generally smooth, the surface is also beset with numerous microspines similar to or somewhat more weakly developed than those on the dermalia. Stauractins are rough near the ends and either nearly plane or slightly arched. They are of rare occurrence among the gastralia. The rays, perceptibly tapering toward the rounded tip, are nearly all uniformly thick, though sometimes slightly swollen at the center.

Oxyhexasters are commonly represented by hexactinic forms, and somewhat less frequently by hemihexactinic and normal forms. The former two are abundantly present in the hypodermal, hypogastral, and parenchymal layers, especially the hexactinic form, which is much commoner everywhere. Two forms of normally developed oxyhexasters are occasionally found in the endosome and in the choanosome. In the endosome, the delicate oxyhexasters (fig. 11, *i*) are rarely intermingled with common robuster forms. These robuster normal oxyhexasters (fig. 11, *j*) measure 90μ to 110μ in diameter. Two to four stouter terminals with slightly rough surface, measuring 52μ in length and widely diverged, are attached to the broad principals which measure 6μ in breadth. Hexactinic forms (fig. 11, *e*) are very abundant throughout. They have six broad, strong rays, 45μ to 60μ long, which taper strongly toward the sharply pointed end, measuring 4μ to 8μ at the base. The entire surface is slightly rough and tuberculated, except at the base. Besides this form much smaller hexactinic forms (fig. 11, *g*, *h*) with the surface entirely smooth, occasionally occur, in all probability a partly developed, or younger, form. The hemihexactinic form (fig. 11, *d*, *f*) may be present together with the hexactinic form. They show nearly the same features, with big rays, as those occurring in other members of the genus, measuring 90μ to 100μ in diameter.

The macrodiscohexaster (fig. 11, *l*) shows a regularly spherical form, measuring 230μ to 320μ in diameter. From a central sphere 55μ to 75μ across, there arise numerous straight, smooth-surfaced

terminals, radiating uniformly in all directions. They have a minute terminal disk, the margin of which shows a row of 2 to 14 small teeth. The terminals always appear to have been regularly arranged in their positions and not situated promiscuously as those of *A. schulzei;* they usually radiate uniformly in all directions, forming two circles; the inner circle is always composed of shorter terminals, which stick densely together in great numbers. The longer terminals are arranged sparsely on the outer circle. This spicule is very common in the gastral membrane and fairly so in the endosome and the choanosome, but is not found on the dermal membrane. This can easily be verified with a hand lens.

The microdiscohexaster (fig. 11, *k*), of a delicate nature and with a diameter of 40μ to 45μ, is common in the parenchyme, hypoderm, and hypogastral layers. It is spherical in shape and provided with exceedingly fine terminals 10μ to 12μ long. The principals are noticeably broad and form a cross about 18μ in axial length. Their outer ends do not show a distinct disklike expansion but become somewhat broader than the middle of the principals, and in the central part they are weakly spherically swollen.

AULOSACCUS PINULARIS, new species

A single specimen in the collection (Station 4790) has served as the type of this new species (U.S.N.M. No. 22112). In general appearance, this sponge resembles *A. schulzei* Ijima from Sagami Sea. It is exquisitely vaselike, broadest in the upper third of its length, and gradually narrowed below. The total length of the stock is 135 mm; greatest breadth, about 85 mm. Above the broadest portion, the wall curves in more or less to terminate in a much-injured, thin, oscular margin, which may have flared out slightly. The osculum is nearly circular, with a diameter of approximately 55 mm. The wall in the middle of the upper half is 10 mm thick; in the middle of the lower half, 19 mm. The greater part of the dermal skeleton has fallen off. Where preserved it shows an exceedingly delicate dermal layer supported below by fine hypodermal strands that intersect one another at various angles. The parenchymal mass, exposed by abrasion, presents a somewhat curly appearance. The apertures to the incurrent canals are medium sized or smaller.

The gastral surface is well preserved. It is lined throughout with a continuous layer of the delicate endosomal skeleton. This consists of a small and irregularly meshed latticework of thin hypogastral strands bearing gastralia, which, without forming a continuous layer by themselves, leave the hypogastral meshes more or less freely open. The surface features of *pinularis* are largely common to all species of the genus. The excurrent canalar apertures are

all small in the upper part of the gastral cavity. Lower down, larger ones become interspersed. The openings of all are covered by the sievelike layer of the gastral skeleton.

Spiculation.—The parenchymalia are all slender diactins either in a loose feltlike arrangement or grouped together into moderately thick, ill-defined bundles. The principal may attain a length of 6 mm or more and a breadth of 52μ at the middle; it tapers gradually toward both ends, which are rough and conically pointed. All sizes down to comitalia only 12μ in thickness are to be found. All the smaller diactins have roughened ends, which taper very slightly to a conical tip, measuring 8μ broad.

The hypodermalia and hypogastralia are likewise diactins; pentactins are not present. They are generally 20μ in breadth and less than 1.5 mm in length. They quite agree in appearance with similar-sized parenchymalia, except in the fact that the spicular center is often, but not always, externally marked by an inconspicuous annular swelling.

The dermalia are hexactinic pinules, so far as those of the body proper are concerned. The pinular distal ray as a whole is spindle-shaped; it is 110μ to 160μ long and 14μ to 18μ broad in the middle, which is about the broadest part. In this part the obliquely upwardly directed, elongate, conical spines may be as long as 8μ. The rhachis is smooth for a short distance at the base, which is about 8μ thick; its conically pointed, outer end forms the tip of the pinular ray. The remaining five rays are somewhat slender and bluntly pointed at the end. They are beset with small, usually erect prickles, sparingly at the base but more pronounced at the end; length, 110μ to 120μ. The proximal ray is usually slightly shorter than the paratangentials of the same pinule, measuring 105μ to 130μ in length. The fine quadratic-meshed dermal latticework is formed by two to six paratangentials of two to six adjoining pinules lying side by side for nearly their entire length. Here and there, among the dermalia, I have found such forms as may appropriately be regarded as early stages in their development. They are much smaller, slender-rayed hexactins, in which either there is no distally directed ray or it is but little differentiated from the other rays, being nearly as prickly as these.

The gastralia are pinularlike hexactins. The free ray is much longer, 260μ to 300μ long and 8μ to 12μ broad at the base, beset with strong prickles, which are projected obliquely upward and pronounced at the extremity. The remaining five rays are all slenderer and gradually taper toward the conically or sharply pointed end. But frequently one of the paratangentials shows a somewhat pinularlike appearance and is provided with strong prickles at the end.

The distal ray is the smallest and shortest of all, measuring 180μ to 220μ in length and sharply pointed at the end, while the paratangentials are usually somewhat longer and bigger than the distal ray, 200μ to 240μ long.

The oxyhexaster consists of normal oxyhexaster and hemihexactinic and hexactinic forms. The normal oxyhexaster is abundant, measuring 125μ to 160μ in diameter. Two varieties of this spicule can be distinguished from the characters of the ray; both seem to occur together promiscuously. In the one the center is swollen to a globular shape, and the very short principals are somewhat rounded in a knoblike manner. Terminals are slender, mostly rough but occasionally smooth, usually three or four arising from each principal. It seems that this is the more abundant of the two oxyhexaster varieties.

In the other form the terminals are usually two in number and slightly stronger, while the principals are much less distinctly indicated, being in fact quite abortive. Insignificant microtubercles are sometimes seen on the surface of the terminals. They measure usually 110μ to 115μ in diameter.

Hemihexactinic and hexactinic forms are also intermixed with the normally developed oxyhexaster in the choanosome of the sponge body. They measure 120μ to 160μ in diameter. The terminals, which look moderately strong, are about 10μ thick at the base, and their surface is obsoletely rough. The latter occurs usually much more abundantly than the former.

The macrodiscohexaster resembles that occurring in *A. ijimai* (Schulze). It is sunlike in appearance, measures nearly 200μ to 430μ at the axis of the rosette, and is present mostly in the choanosome.

From the end of the principals, which are separated by six hemispherical bosses measuring 45μ to 55μ across, there arise numerous very long and slender terminals, radiating uniformly outward. Terminals are filamentlike, obscurely rough-surfaced, and furnished with a disk at the end, which is somewhat conically convex on the outer side. It measures about 12μ in diameter. The margin shows a row of numerous small teeth.

Microdiscohexasters of spherical shape and 40μ in diameter are not uncommon in or near the endosomal layer. They were occasionally observed in the ectosome also. From a nearly spherical node arise comparatively thick principals, which in length are about one-third the radius of the rosette, each of which carries at the outer end a small disk, usually provided with a central tubercular prominence on the external side. The terminals are very fine and difficult to count, but there are probably not more than 10 to each principal.

Remarks.—This new species resembles *A. ijimai* in essential mode of spiculation but differs from it in the shapes of the dermal and gastral hexactins and the outer feature of the parenchymal oxyhexaster.

BATHYDORUS UNDETERMINED

Here are mentioned three specimens that I have studied but which I prefer to leave unnamed. I provisionally place them in the genus *Bathydorus*. One of them is very small and probably a young specimen in which the characters have not been fully developed. The other two are broken into several fragments, which were preserved in a badly macerated condition.

BATHYDORUS, *a* species

PLATE 6, FIGURE 2

This is a little specimen collected at Station 4917, about 90 miles west by southwest of Kagoshima Gulf at a depth of 361 fathoms, together with *Sericolophus reflexus* (Ijima). The body is barrel-like in shape, measures 14.5 mm high and 7 mm broad, and is attached to a mass of pebbles. From the body proper arise fine prostal needles of a considerable length, mostly directed obliquely upward and outward. The dermal surface is smooth. The parenchymalia are chiefly diactins less than 12μ thick. Nearly all the surface is smooth; occasionally it is rough at both ends.

The dermalia are predominantly stauractins, the plane of which is usually slightly convex on the outer side. The length of their rays varies from 65μ to 80μ. They are 4μ in breadth at their base.

The relatively strong and slightly tapering rays are entirely rough with distinct but sparse microtubercles. The atrophied rays are entirely absent in the present spicule.

The gastralia are hexactins found in dense but irregular distribution. They do not form a regular latticework. The surfaces of the rays are much more prominently microspined. The paratangentials usually measure 70μ to 80μ in length; the distal ray is shortest of all, while the proximal is 120μ to 180μ long, tapering toward the pointed and curved ends.

The hypodermalia are moderately large pentactins, with their rays gradually tapered toward the conically pointed ends. The paratangentials measure 360μ to 400μ in length and 12μ to 16μ in breadth near the spicular center. The proximal fifth ray is always longer than the paratangential in the same spicule and at times is nearly twice as long. Seen in surface-view preparations, the paratangential crosses are situated for the most part without any regular or "mutual" arrangement, though at places they approach the formation of a quadrate-meshed latticework.

The oxyhexasters are common, but not abundant, in the choanosome, as well as in the subdermal and in the subgastral spaces. They are characterized by rather longer terminals, as compared with the principals, and are slender, quite smooth on the surface, and, though bent at the base, are nearly straight for the rest of their length, and so diverge from one another as to give a spherical shape to the entire spicule. This measures 110μ to 120μ in diameter. Principals bearing less than two terminals probably never occur; there are two or three in most cases.

The only kind of discohexaster present is comparable to the microdiscohexaster of certain other rossellids. It measures only 3.04 mm in diameter. The convex disk at the outer end of each fairly strong principal bears a bunch of numerous and exceedingly fine divergent terminals, each of which ends in a minute terminal knob. The shape of the entire rosette is spherical. In some parts the discohexasters in question were found only occasionally; in other parts of the same specimen they were quite common, occurring near the subdermal or subgastral regions, where they seem to be present in nearly equal numbers to, or are somewhat more numerous than, the oxyhexasters.

The described spiculation seems to come nearest to, and indeed closely resembles, that of *Vitrollula fertilis*. But, as the parenchymal hexactins are lacking, I should prefer not to make a definite specific determination.

An interesting fact regarding the specimen is the presence of certain peculiar small bodies lodged in large numbers among the tissues of the choanosome. Ijima has already noted these in *Staurocalyptus glaber*. To the naked eye they appear as whitish spots of various sizes of about or less than 0.5 mm diameter. Under the microscope the body is found to be a reticular mass of no definite shape, consisting of an irregular rigid framework of microtuberculate beams. The mass is always completely transversed by a few parenchymal diactins of the sponge. These reticular bodies treated of are also like those described by F. E. Schulze from the buds borne on the prostal lateralia of *Rhabdocalyptus mirabilis*.

BATHYDORUS, β species

Several poorly preserved fragments were obtained from two stations: No. 4769 (Bowers Bank, Bering Sea, depth 244 fathoms), and No. 4770 (Bowers Bank, Bering Sea, depth 247 fathoms). As the specimens are macerated and broken into several fragments, it is impossible definitely to determine whether they are identical.

The principal parenchymalia are the rather numerous and elongated bowlike diactins, 160μ to 200μ long, the middles of which are not always externally marked by a swelling. They are practically smooth on the surface, gradually tapering toward both ends.

The smaller parenchymalia down to comitalia only 10μ in thickness are of the usual description. The tips are acuminate, rounded, conical, or mucronate; infrequently they are swollen to a clublike or even a bulbous shape.

Hypodermal pentactins are well developed and show essentially the same characters and arrangements as in common members of *Staurocalyptus*, being isolated or sometimes standing out in small loose groups. Paratangentials do not exceed 4 mm in length; the shaft is longer, measuring up to 7 mm. They are either paratropal or almost regularly cruciate. The surfaces of all rays are quite smooth except at the ends, the surface of which is roughened by densely distributed microtubercles. All the rays are gradually attenuated toward the conically or sharply pointed ends.

The dermalia are rather thick-rayed pentactins, with the unpaired ray directed proximally. Their paratangential rays are in a plane slightly arched on the inside. Occasionally stauractins are found, intermingled here and there with the former spicules. The paratangentials, from the central point, measure 90μ to 100μ, while the proximal unpaired rays are 100μ to 110μ in length. The thickness at base averages 12μ. The rays are slightly narrowed outward; the tip is rounded or somewhat conically pointed. Their surface is thickly beset nearly all over with distinct microspines, which are much more pronounced at the ends. In the stauractins, the rays are somewhat longer, 120μ to 135μ long, also in a plane, slightly arched on the inside. The aborted rays of both spicules are at most represented by vestigial bosses.

The gastralia are strong and long hexactins, for the most part fully twice as long as the dermalia. The rays are somewhat more tapering toward their ends; the microspines or microtubercles on the surface are in like manner moderately developed. Length of rays: Paratangentials, 130μ to 180μ; distal ray, 130μ to 160μ; proximal, 180μ to 210μ. The rays at the base are somewhat slender, averaging 8μ thick.

The oxyhexasters consist of three kinds, namely, normal oxyhexaster, hemihexactinic, and hexactinic. The normally developed oxyhexaster occurs less abundantly in all parts, but it is especially plentiful near the ectosome. Its diameter is 90μ to 135μ. There is no appreciable difference in appearance between those in the periphery and others situated more deeply in the wall. From each exceedingly short principal two or three rather thin, obscurely rough-surfaced, and nearly straight terminals diverge. Occasionally the principals appear distinctly circular-knoblike in shape, measuring 10μ in size. Oftener the oxyhexasters seem to be hemihexactinic and occasionally quite hexactinic forms. In the hemihexactins, the diameter meas-

ures 80μ to 110μ, while in the latter it is 150μ to 210μ across. Of the hemihexactinic forms, the total number of terminals to the entire rosette may vary from 5 to 11, indicative in each case of the number of the principals that remain biterminal and of those that become uniterminal.

Much less numerous than the oxyhexasters are the microdiscohexasters, which vary considerably in size, measuring 30μ to 60μ in diameter. They are thinly distributed both subdermally and subgastrally, though they seem to be much commoner in the gastral regions. The shape is spherical; the terminal disk is minute, not pinheadlike, but is a small laterally expanded disk.

Genus ACANTHASCUS F. E. Schulze, 1886

ACANTHASCUS PACHYDERMA, new species

FIGURE 12; PLATE 5, FIGURE 1

This species is based on a single complete specimen (holotype, U.S.N.M. No. 22123) collected from a depth of 229 fathoms southeast of Shimushir Island, Kuriles (Station 4803). It has an elongated barrel shape. The lower end is somewhat contracted into a stalklike base, 27 mm broad, gradually becoming broader toward the upper end. The total height is 88 mm; the greatest breadth near the anterior end of the body is 39 mm. The osculum at the superior end of the stock is elliptical in form, the greater diameter being 18 mm and the smaller 11 mm. The deep gastral cavity extends almost into the stalklike base. The body wall in the middle is as thick as 10 mm and is of nearly the same thickness toward the simple-edged oscular margin.

The external surface is quite smooth, but shows indications of a number of small and large tubercles, measuring 1 mm to 3 mm across in the lateral side of the entire stock. The more prominent of these tubercles may have been 2 mm in height. The wall is firm, on account of the closely interwoven state of the hypodermal spicules as well as of the small size of the canals. Nearly all the irregularly quadrate-meshed dermal latticework is torn off. It partly covers the incurrent apertures, which are less than 2 mm in diameter. Their apertures are irregularly placed and are indistinctly visible through the latticework. The gastral surface appears smooth, but the excurrent apertures may be distinctly observed, 2 mm to 3 mm in diameter, distributed irregularly.

Spiculation.—Principal parenchymalia are fairly long diactins, 4.5 mm or more in length and up to 20μ in thickness at the middle. They taper gradually toward the conically pointed or rounded ends, the surface of which is much less strongly roughened than that of

the middle part of the spicule. There are frequently much slenderer, curved diactins, forming small bundles close together. At any rate the parenchymal diactins are somewhat slender in form and are

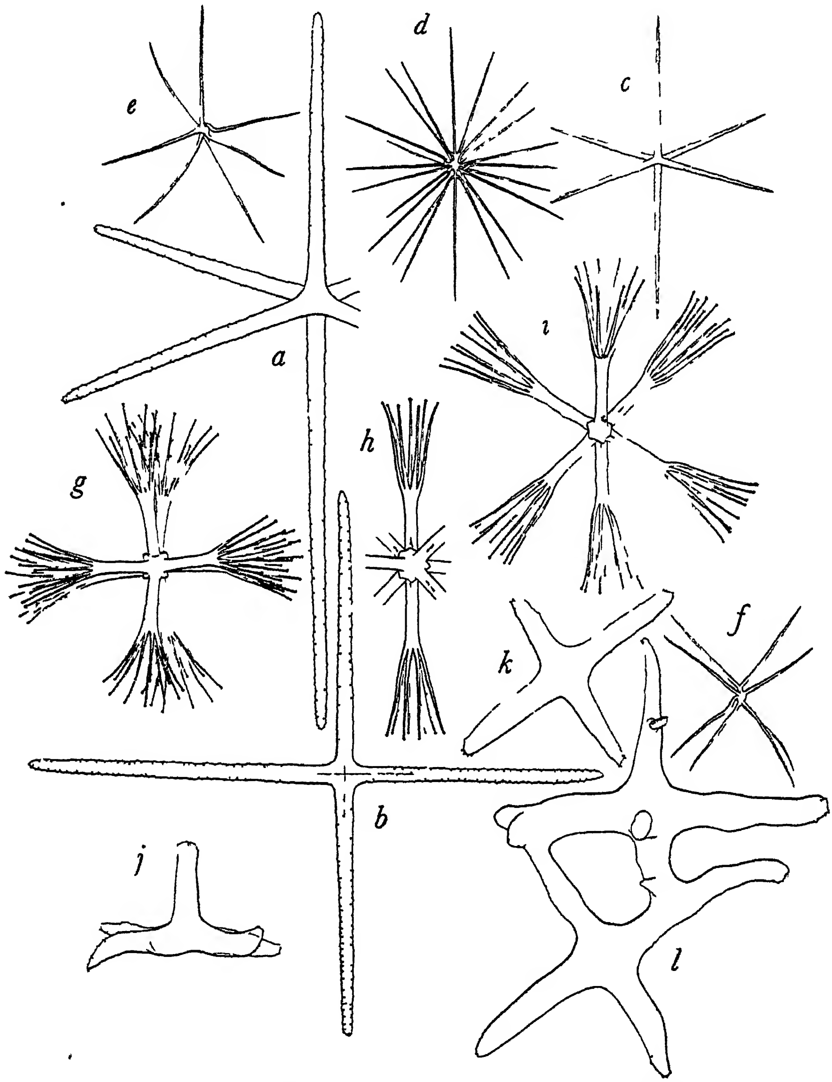


FIGURE 12.—*Acanthascus pachyderma*, new species: *a*, Gastral hexactin, × 225; *b*, dermal stauractin, × 1,875; *c*, hexactinic form, × 225; *d*, oxyhexaster, × 375; *e*, oxyhexaster (form A), × 375; *f*, oxyhexaster (form B), × 375; *g–i*, discoctasters, × 375; *j–l*, basalia, × 225.

distributed much more irregularly and sparsely than those of the hypogastral layer.

Hypodermal diactins are loosely arranged and do not form strands, as do those occurring in the hypogastral layer. They are wider but

usually shorter than hypogastral diactins. They may attain a length of 170μ and are 16μ wide at the middle. The width is nearly the same throughout, slightly tapering toward the rounded ends, the surface of which is roughened by microspines. The diactins are distributed densely, forming a thickened firm layer 1 mm in thickness. Occasionally diactins that have a central protuberance appear. They are 550μ in length and 20μ to 24μ wide at the center. The surface, except that of the central protuberance, is roughened sparsely.

Hypogastralia also consist of diactins, which are arranged in loose or compact bundles of variable length, distributed much more sparsely and irregularly. They are generally slenderer than those on the hypodermalia but much longer than the latter. They taper very gradually toward both ends, the tip being either simply acuminate or conically pointed. Subterminally the surface is sparsely roughened by microspines. Occasionally in the diactins the center shows a gentle swelling, but more frequently four protuberances, like those occurring in the hypogastralia.

Dermalia are predominantly stauractins (fig. 12, *b*), sparsely rough all over, nearly plane, not arched; axial length, 280μ to 360μ. The rays taper perceptibly toward the conically pointed or rounded tip, or are nearly uniformly thick. They are sometimes provided with a central prominence. The thickness at the middle averages 8μ. Occasionally among the dermalia there are found pentactinic forms in which the proximally directed, unpaired ray is somewhat shorter or longer than the paratangentials, 140μ to 200μ in length. The surface is also sparsely roughened. Besides these common stauractins and pentactins, a smaller and very slender stauractin occasionally occurs. Its rays are very slender, measuring 2μ to 4μ wide at the middle, and are sharply pointed at the ends.

Gastralia are rough large hexactins (fig. 12, *a*), irregularly scattered. The rays taper slightly outward. The microtubercles on their surface are neither numerous nor strongly developed, so that the roughness on the surface is not prominent. The proximal ray measures 212μ in length; the distal ray 190μ, and the paratangentials 175μ.

Oxyhexasters consist of normal oxyhexaster (fig. 12, *d*), hemihexactinic, and hexactinic forms, the last of which is rarely found in the parenchyme. The normal oxyhexaster may be present in two forms, designated A and B, differing in total size, in the slenderness of the terminals and in the shape of the principals. The variety B (fig. 12, *f*) frequently occurs in the dermal and gastral layers, as well as abundantly in the parenchyme, intermingled with the other variety. It measures 140μ to 155μ in diameter and has a distinct globular node and short principals, rounded in a knoblike man-

ner at the ends. Slender, sparsely roughened terminals, generally two or three in number, arise from each principal. They are apt to be broken off near the base. It seems that this form is the more abundant of the two varieties.

In variety A (fig. 12, *e*) the terminals are considerably stronger, being nearly 5μ in thickness at the base, while the principals are much less distinctly indicated, being in fact quite abortive. They are obscurely rough all over. There are generally two terminals to each principal, never more, rarely only one. The principal measures 172μ in diameter. The hexactinic form (fig. 12, *e*) is somewhat larger, measuring 190μ in diameter and having roughly surfaced terminals which are pointed at the ends. The hemihexactinic forms are somewhat smaller, measuring about 150μ across, and are provided with delicate and slender terminals. These two forms are distributed fairly abundantly, intermixing with the normal oxyhexasters in the parenchyme.

Discoctasters (fig. 12, *g*, *h*, *i*) are common in all parts, being especially abundant near the ectosome and the endosome. They measure 180μ to 220μ in diameter. The principals are 8μ thick at the base, fairly slender, and 40μ long. The number of principals projecting from the spicular center varies from 6 to 8; in most cases 6 and less often 8, of which 6 protrude laterally and the remaining 2 forward and backward. In other cases, the pairs protrude from the spicular center in all directions. The number of terminals in a tuft is 5 to 12, each with a minute terminal disk. They are usually somewhat longer than the principals, measuring 56μ in length, with their tuft narrow at the base and slightly expanded distally. This discoctaster has a distinct quadrangular humplike prominence measuring 20μ in diameter on the central node. The terminal disk is very small and pinheadlike. The microdiscohexaster is found abundantly in the parenchyme. Spherical in shape, it is similar in appearance and in structure to that of all members of the genus, so that a special description appears unnecessary. It measures 40μ in diameter.

The basidictyonal plate (fig. 12, *j*, *k*) is represented by a fairly large-meshed siliceous reticulum, the beams of which may measure 20μ broad at the widest part and have a smooth surface. In isolated instances much more robust pentactins are found (14μ to 18μ in breadth, and paratangentials 32μ to 48μ in length), and oftener stauractins having nearly the same or a greater axial length. It is not difficult to make out that the foundation of this plate is formed of the stauractins and pentactins above mentioned, which are directly as well as synaptically fused together.

ACANTHASCUS CACTUS F. E. Schulze

Acanthascus cactus F. E. SCHULZE, Abh. kön. preuss. Akad. Wiss. Berlin, 1886, p. 49; Rep. Voy. *Challenger*, vol. 21, p. 148, pl. 57, figs. 1–7, 1887.—IJIMA, Annot. Zool. Japon., vol. 1, p. 48, 1897.—F. E. SCHULZE, Sitz-ber. kön. preuss. Akad. Wiss. Berlin, vol. 26, p. 551, 1897.—IJIMA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 18, art. 7, pp. 140–158, 296, pl. 11, figs. 16–22, pl. 12, figs. 23–37, 1904.

Specimen A expands somewhat superiorly in such a manner as to take on a funnellike shape, as shown in Ijima's Contribution IV, page 142, Figure 6, D. Height, 140 mm. Broadest part of sponge body, 70 mm. Near the basal end it measures 45 mm. As the preserved sponge is extremely compressed laterally, the exact size of the osculum can not be ascertained. It probably measured 45 mm to 65 mm. The wall of this specimen is thicker than in specimen B, measuring up to 6 mm in the middle of the entire stock. The body is nearly completely preserved, lacking a basal attachment and even a basal plate. The sharply apexed conical elevation of the external surface occurs at various but rather wide intervals, measuring about 17 mm high. On the oscular edge there may occur very fine prostal marginalia, which always project singly, without forming small tufts.

In the smaller specimen (B) the lower parts of the entire stock are much more dilapidated. It measures 76 mm high and 60 mm wide at the broadest part of the sponge. The wall in the middle is about 2 mm thick. There are no numerous conical elevations, as in specimen A.

TABLE 21.—*Record of specimens of* Acanthascus cactus

Specimen	Collected at—	Number and description
A	Station 5088, Sagami Bay, 369 fathoms	One, large, nearly complete.
B	do	One, small, lacking inferior parts of body.

Spiculation.—The prostal marginalia are not distinct, projecting simply from the thin edge of the osculum. They are very fine diactins, measuring about 2 mm long and 0.5 mm thick in the middle, being smooth on the surface with the exception of both ends.

Although the simple hexactins in the parenchyme were not seen by previous observers, they were found occasionally in both specimens. Paratangentials are of nearly uniform length, being 48μ long, and the distal and proximal rays 56μ long, and tuberculated on the entire surface.

As noted by previous authors, the gastralia usually consist of rough pentactins and occasionally of stauractins, but besides these I have

occasionally found rough hexactins having paratangentials of nearly equal length, 90μ to 115μ long and 8μ to 10μ broad at the base, with proximal and distal rays measuring 120μ to 134μ in length.

As regards the occurrence of the abnormality of the oxyhexaster of this species described by Ijima, I have met with a discoctaster in these specimens that represents what seems to be a case of abnormal development. This occurs occasionally in the dermal membrane of both specimens. It measures 72μ in diameter with an irregularly shaped central node 14μ broad, with no indications of the normal principals dividing into more than 30 terminals. Each terminal ends in a very small pinhead.

Genus STAUROCALYPTUS Ijima, 1897

STAUROCALYPTUS RUGOCRUCIATUS, new species

FIGURE 13; PLATE 6, FIGURE 4

A single small specimen of this species (holotype, U.S.N.M. No. 22051) was obtained from a depth of 426 fathoms off Bowers Bank, Bering Sea (Station 4771). The sponge body is a pair of elongated, thick-walled, pear-shaped sacs. From the base the breadth increases somewhat gradually until over mid-height is reached when it decreases rapidly toward the oscular opening. The total height is 46 mm. Near the lower parts it is irregularly shaped and bent inward; the maximum breadth at mid-height is 25 mm. The osculum, which is elliptical in outline, measures 5 mm by 15 mm. The margin is fairly thick and simple-edged. The body wall is thick, decreasing gradually from 8 mm near the base to 2 mm near the oscular margin. Projecting from all parts of the outer surface of the sponge are many long, robust prostalia, forming a definite and distinct fringe at the oscular margin. They are more abundant in the lower portion of the sponge than in the upper. Those projecting directly outward from the oscular margin measure 10 mm to 15 mm in length. The gastral surface is smooth and has numerous evenly distributed circular openings about 0.5 mm in diameter. The diactinic prostals are somewhat weaker needles of various lengths. They project to a free length of 5 mm to 15 mm or more, being directed on the whole obliquely and outward. The pentactinic prostals are of a moderately large size, and may form a gossamer-like covering over the dermal surface. They generally protrude in groups of two or more, but sometimes stand out singly.

Spiculation.—The prostal diactins, which are primarily to be regarded as enormously developed parenchymal principalia, are of various sizes. A small one may measure 10 mm in length, while the larger measure 35 mm long and 170μ thick at the middle. These

spicules are straight and taper perceptibly toward both ends. The outer and inner ends are acutely or bluntly pointed, the entire surface being smooth and not beset with microtubercles.

Comitalia are slender diactins, measuring 20μ, with a smooth surface, except at both ends, where they are roughened by microtubercles. They are broad at the middle and nearly as long as half of the entire length of the prostal diactins.

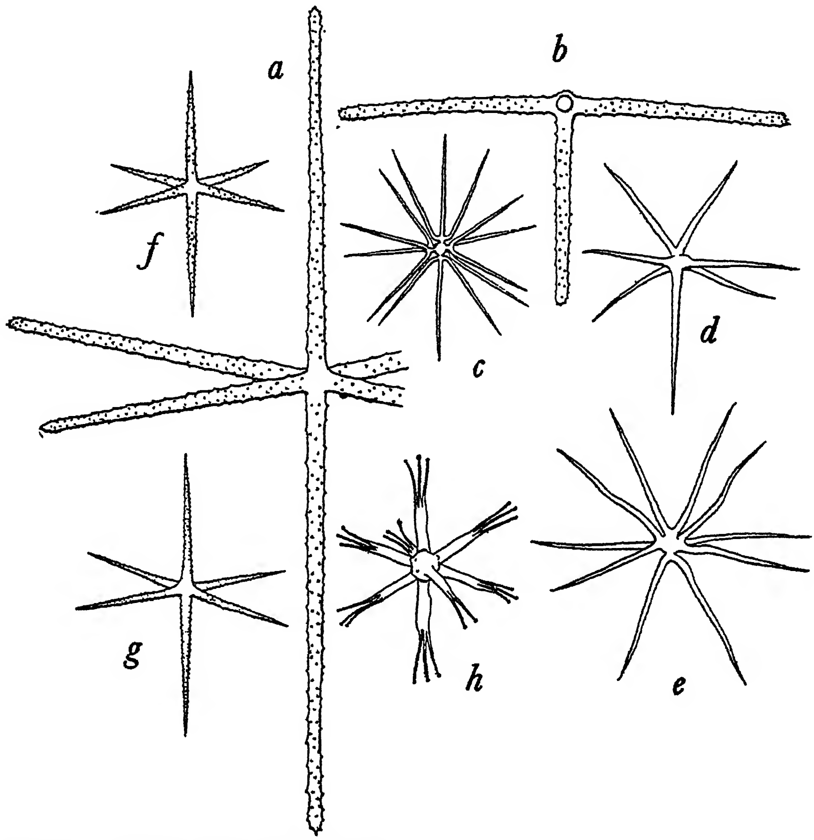


FIGURE 13.—*Staurocalyptus rugocruciatus*, new species: *a*, Gastral hexactin; *b*, dermal pentactin; *c*, oxyhexaster; *d*, *e*, hemihexactinic forms; *f*, *g*, hexactinic forms; *h*, discoctaster. All × 250+

The parenchymalia are composed of large and small oxydiactins, either nearly straight or gently bent in a bowlike manner. They may attain 5 mm in length and 170μ in breadth at the middle. The ends are usually prominently microspined in varying degrees. In some of these diactins, one end is slightly rounded, but most of them are acutely pointed at both ends. The smaller diactinic parenchymalia with 2 or 4 knobs at the middle and 300μ to 400μ in length,

occur in the hypodermal and hypogastral layers. They are microspined on the entire surface, most pronouncedly so at the end. They are frequently smooth near the center.

The hypodermal pentactins are somewhat variable in size, the larger ones usually occurring lower down on the sponge, while the small ones, measuring not more than half the size of the larger ones, are situated near the oscular margin. I have found that the small pentactins are generally arranged in the form of a regular cross. This cruciate arrangement of the paratangentials also occurs rather rarely in the larger pentactins lower down on the sponge. The larger pentactins are usually protruded singly from the lower parts of the sponge surface. The paratangentials, which are generally not quite straight but rather wavy, are 4 mm or more long. The straight shaft or the unpaired proximal ray is always much longer than the paratangential in the same spicule. All the rays of the pentactins are at first smooth or very sparsely rough except near the ends, which are minutely rough. They are so in most of the spicules in the hypodermal situation or in the oscular margin; while the older pentactins present a finely shagreenlike surface throughout the lower parts of the entire stock. The roughness is caused by minute, erect, and sharply pointed processes. The fine shagreenlike surface is caused by the same minute and thickly set processes. The microspines remind one of those on the prostal pentactins of *Staurocalyptus dowlingii* (Lambe). In general, the surface of the rays in the pentactins is more thickly microspined on the paratangentials and more sparsely so on the proximal unpaired ray.

The dermalia are mainly rough pentactins. Exceptionally they may be stauractins, rarely hexactins. The pentactins (fig. 13, *b*) measure 150μ along both the paratangential rays and the unpaired proximal ray, which is somewhat shorter than, or nearly equally as long as, the paratangentials. The thickness at the middle is 8μ. They are straight and taper very slightly toward the rounded or conically pointed ends. All the surfaces of the rays are sparsely roughened. The stauractins are nearly straight on the outside and almost the same size as the pentactins in axial length. The rays are 140μ to 170μ long and 8μ broad at the base. They are entirely rough, and the microtubercles on their surface are more or less prominent. The hexactins are nearly the same as those occurring in the gastralia but are smaller in size.

The gastralia are fairly large hexactins (fig. 13, *a*). All six rays in one spicule may sometimes be of nearly equal length, but more frequently the proximal free ray is the longest and the distal the shortest. The length of proximal ray is 100μ to 250μ; of paratan-

gential rays 80μ to 240μ; and of the distal rays 70μ to 200μ. At the base the thickness averages about 10μ. The rays taper gradually toward the pointed ends and may all be nearly equally rough, on account of microspines, but more pronouncedly so at the distal ends. These hexactins are generally arranged irregularly, and do not form a continuous quadrate-meshed latticework.

The oxyhexasters, occurring in moderate abundance in all parts, are partly normal and partly hemihexactinic and hexactinic forms. In most normal oxyhexasters (fig. 13, *c*) the principals each bear 2 or 3 terminals, so that the total number of terminal points is 12 to 16. Their diameter measures 110μ to 140μ. The terminals are rather strong, measuring about 2μ across at the base, and are straight or wavy and sparsely rough on the surface. The principals are extremely short and often obsolescent. Throughout the parenchyme there are numerous oxyhexasters and hemihexactinic (fig. 13, *d*, *e*) and hexactinic (fig. 13, *f*, *g*) forms, which are seen to be sparsely rough or occasionally densely rough, having numerous microtubercles on the surface and measuring 112μ in axial length. Any one of the principal rays of hemihexactinic form may bear two long, straight or wavy, divergent, sharply pointed terminal rays, thus giving rise to the oxyhexasters, so that all gradations between the 6 and 12 rayed spicules are seen. These several forms are entirely similar to those occurring in *Staurocalyptus dowlingii* (Lambe).

The discoctasters (fig. 13, *h*) are not abundant. They are slender rayed and on the whole small. The diameter is usually 80μ. The central node is plain and very weakly tubercled. The principals are slender, nearly as long as, or much longer than, the terminals. The number of terminals to a principal is frequently three and probably never more than four. They form a very slightly diverging tuft and are nearly straight. On the minute terminal disks the marginal serration is wanting.

Malformed discoctasters, in which one or more primary terminals stand free without fusing with any of the secondary principals, are of occasional occurrence.

The microdiscohexasters are of usual appearance and 50μ in diameter. They are found, mostly in the ectosome and in the endosome, in fairly large numbers though scattered.

The new species, as before mentioned, resembles *Staurocalyptus dowlingii* in outer configuration and in some essential points of spiculation, but differs from it in having a smaller discoctaster and a larger microdiscohexaster.

Genus RHABDOCALYPTUS F. E. Schulze, 1886

RHABDOCALYPTUS BOREALIS, new species

FIGURE 14; PLATE 6, FIGURE 3

As can be seen, this species has passed through my hands in no small numbers. With one exception, all were obtained from the same station. Some were not well preserved, the oscular margin and other parts being damaged. Though these specimens all differ in external appearance, they do show an essential or almost complete agreement in spiculation.

TABLE 22.—*Record of specimens of* Rhabdocalyptus borealis

Specimen	Collected at—	Number and description
A	Station 4772, Bowers Bank, Bering Sea, 344 fathoms	One, large, lacking parts of oscular margin.
B	do	One, large, broken upper parts of entire stock.
C	do	One, large, complete.
D	do	One, fairly large, complete.
E	do	Do.
F	do	Do.
G	do	One, small, lacking the greater upper part of one side of entire stock.
H	Station 4769, Bowers Bank, Bering Sea, 244 fathoms.	One, small, complete

Specimen A represents a belt-purselike form, totally closed at the entire lower end and lacking a special attachment of the entire stock. The specimen is not well preserved, being somewhat dilapidated in parts on the oscular edge. It is expanded outward, all around, and is bent backward. The major and minor diameters of the osculum are 70 mm (exclusive of the flaring rim of about 15 mm in breadth and measured on the inner margin of the osculum). The thin oscular edge is of a finely granular or densely feltlike appearance. The height is 75 mm. The broadest part measures 90 mm and is located below the middle of the sponge body. The wall is 1 mm thick in the middle of the body; lower down it is as much as 1.5 mm thick, and at the margin of the oscular rim as little as 0.8 mm.

Specimen B is very different. It represents a vaselike, or funnellike, form; total height, 145 mm; size of the oval-shaped osculum, 55 mm; breadth of body, 50 mm near the upper end, near the middle 42 mm, and farther below 30 mm. The narrowest part of the entire stock—the basal region—measures only 22 mm from side to side. The thickness of the wall at the middle of the body is 2.5 mm; farther below, near the base of the body, it is 2 mm. The wall gradu-

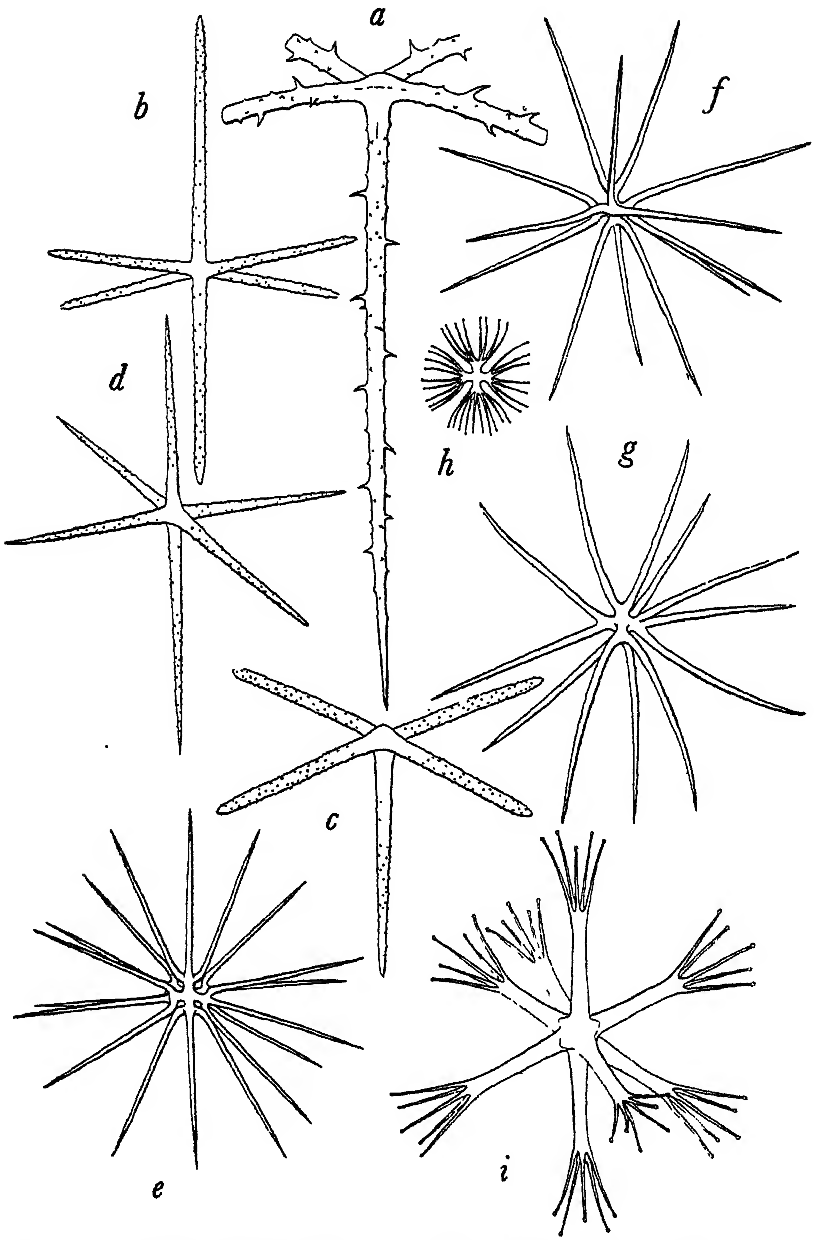


FIGURE 14.—*Rhabdocalyptus borealis*, new species: *a*, Hypodermal pentactin, × 80+ ; *b*, gastral hexactin, × 225− ; *c*, dermal pentactin, × 225− ; *d*, parenchymal oxyhexact, × 425+ ; *e*, oxyhexaster (form C), × 425+ ; *f*, oxyhexaster (form B), × 425+ ; *g*, oxyhexaster (form A), × 425+ ; *h*, microdiscohexaster, × 425− ; *i*, discoctaster, × 250

ally thins out at the oscular margin, which does not flare out. The base can not be said to be solid, since the gastral cavity extends almost to the attachment surface.

Specimen C is elongate-sacciform, 95 mm high, with an oval oscular opening. The broadest part of the body is situated below the middle of the stock and measures 38 mm; the basal part measures only 14 mm. The thickness of the wall is nearly the same as in specimen B, measuring 2 mm in the middle and 1 mm in the lower part.

Specimens D and E are similarly shaped and have bent bodies (at the base) 75 mm in height. The diameters of the oval-shaped osculum are 13 mm and 20 mm, respectively. The broadest part of the entire stock measures 26 mm to 30 mm, and the extremely narrowed stalklike basal region, which is bent toward one side, measures 2 mm to 5 mm in breadth. The thickness of the wall is 2 mm at the thickest part of the entire stock. Both specimens are well preserved, except at their basal ends. The gastral cavity seems not to extend into the extreme end of the basal stalk region but appears close to it.

Specimen F is the smallest of all, and is tubular or vaselike in form, about 30 mm in height and not less than 8 mm in diameter. The wall is 1 mm thick in the thickest part and becomes gradually thinner toward the outer oscular margin, where it measures 0.8 mm. The circular osculum measures 4 mm to 5 mm in diameter. The prostal marginalia measure 15 mm to 20 mm in length.

The greater part of the entire stock of specimen G is broken, the remaining part measuring about 35 mm high and 15 mm broad.

Specimen H (holotype, U.S.N.M. No. 22161) is a cup-shaped sponge, 65 mm in height; the wall at the middle of the entire stock measures 2 mm thick. The greatest breadth of the sponge appears in the superior region; near the lower part of the oscular margin it measures 40 mm.

Spiculation.—The parenchymal principalia are bowlike oxydiactins with tapering or straight rays, which subterminally are occasionally smooth. They may attain a length of 6 mm and a thickness of 102μ in the middle, but are usually smaller. The middle is not externally marked by a swelling. There are no points worth special mention regarding the slender parenchymalia.

The prostal marginalia present on some specimens are needlelike oxydiactins, which may be 10 mm to 17 mm or more long and 12μ to 77μ thick. The rays gradually taper toward the end and are subterminally minutely tuberculated.

The prostal basalia are represented in some specimens. They are nearly the same length as the prostal marginalia but are rather strongly tuberculated at the ends and not extremely narrowed or pointed.

The large prostal pentactins are present usually in the upper two-thirds of the entire stock; they seem to become lost as somehow they are shed off in the lower parts. Diactinic prostalia were not ob-

served in specimens A–C, either at the rim of the oscular margin or in the lateral wall of the entire stock. But in the remaining specimens, long, diactinic prostalia project beyond all parts of the outer surfaces. They do not occur in large numbers nor do they form a definite fringe at the oscular margin (except in specimen F), though they are more abundant in the upper portion of the sponge than elsewhere. These marginal and pleural prostalia are smooth on the surface, frequently reach a length of 20 mm and have a maximum thickness of about 180μ.

The hypodermalia are strongly developed diactins, oxypentactins with paratropal paratangentials and pentactins. There are usually in each group one or two pentactins that have entirely smooth paratangentials, except at the ends; they may be the youngest of all in the group. The older pentactins (fig. 14, *a*) usually are situated at a higher level than the younger (this is characteristic of all *Rhabdocalyptus* species) and have the paratangentials armed from base to tip with strong, straight or slightly curved, and sharply pointed prongs, arranged in two series along the lateral sides of the rays. The prongs are placed at fairly regular intervals, those of the two sides alternating with one another. In the basal parts of the rays, the strongest prongs may be 119μ long; there they all spring out vertically, frequently bend forward away from the dermal surface. Toward the tip of the rays and along with the gradual tapering of these, the prongs grow continually smaller. Apart from the above prongs, the surface of the paratangentials is perfectly smooth, except at the microtuberculated end. The unpaired shaft ray is occasionally pronged, but then not so numerously as in other rays. The paratangentials of the older pentactins are 20 mm to 50 mm long, and the shafts 40 mm to 90 mm. The rays are not more than 85μ thick at the base.

The dermalia are predominantly pentactins (fig. 14, *c*), which have short, rough, microtuberculated tangential rays 90μ to 100μ long; proximal ray 75μ to 85μ long. Less often, among the dermalia, stauractins are found lying with their rays in the dermal plane and still more rarely hexactins somewhat smaller than those in the gastral layer.

The gastralia are rough hexactins (fig. 14, *b*) with rays exactly like those of the dermalia; length of rays, 152μ to 190μ; breadth at base, 12μ. Occasionally all six rays in the same spicule are subequal, though in most cases the proximal ray is somewhat longer than the paratangential and the distal rays. They measure 152μ to 176μ in length. The microtubercles are slightly more pronounced on the proximal ray than on any other.

The oxyhexasters occur in abundance in all parts of the sponge wall and are of three slightly differing forms, designated herein by

the letters A, B, and C. Forms A and C are chiefly in the ectosome or endosome, and form B is common everywhere, intermixed with other forms, though less numerous in the endosome.

The A oxyhexasters (fig. 14, *g*) are distinguished by having very slender, slightly wavy and slightly roughened terminals. Each very short principal usually carries two slightly curved terminals. The diameter of the oxyhexaster, 112μ, seems to be greater than in form B. Form A is not so numerous as the remaining forms.

Form B (fig. 14, *f*) is 88μ to 100μ in diameter and occurs everywhere. It is by far the best represented of the three forms, occurring in greatest abundance of all these spicules. It is distinguished by having nearly straight and rough terminals, which seem not to be so fragile as those in the form A. Each very short principal is provided with two, occasionally three, straight, slightly rough terminals. This roughness becomes more or less pronounced toward the base, but not so prominent as to form microspines or barbs. The terminals measure 48μ to 52μ long.

Form C (fig. 14. *e*) resembles form B in shape and size. It is distinguished from the other forms by having very broad, strong principals, to each of which are attached widely diverged strong terminals. These principals are of a perceptible length, 4μ; and there are usually two, sometimes three, terminals to a principal. They usually measure 49μ to 52μ long and have a smooth surface. This oxyhexaster is represented in nearly the same numbers as form B, but is more abundant in the endosome of the sponge. Throughout the parenchymalia are a few oxyhexacts (fig. 14, *d*), which are rough on the surface. The proximal and distal rays are 48μ long and the tangential rays 40μ.

Discoctasters (fig. 14, *i*) commonly occur among the parenchymalia and are occasionally found in the ectosome, as well as in the endosome. The six prominent bosses present on the central node frequently form a large tuberculated mass, measuring 12μ by 18μ across. The principals are slender, at most 4μ thick; about one-half or more the length of the entire ray, measuring 20μ to 32μ long. The fine terminals are four to six in number, in a gently expanding tuft measuring 16μ to 30μ in length, and have very minute terminal disks shaped like a pinhead. The diameter of the spicule is 80μ to 120μ.

The microdiscohexaster (fig. 14, *i*) is relatively small, measuring 25μ in diameter. I have found it sparsely distributed everywhere, though it is most frequently in the dermal and gastral membranes. The principals are slender and form a cross measuring about 8μ in axial length. The number of terminals may reach 10 to 12, measuring 5μ long.

This new species seems to agree closely with *Rhabdocalyptus australis* Topsent in outer appearance and in essential characters of spiculation, but differs from it in three respects: In our species (1) the surface of the prostal paratropal pentactins is smooth, except at the end, instead of microtuberculated over the surface; (2) oxyhexasters consist of three kinds and usually have smooth or slightly rough terminals; (3) the discoctaster has four to six terminals to each principal, instead of three to four.

RHABDOCALYPTUS HETERASTER, new species

FIGURE 15; PLATE 6, FIGURE 6

The two complete specimens of this species were collected from the Station 4770 (Bowers Bank, Bering Sea, 247 fathoms). Both of

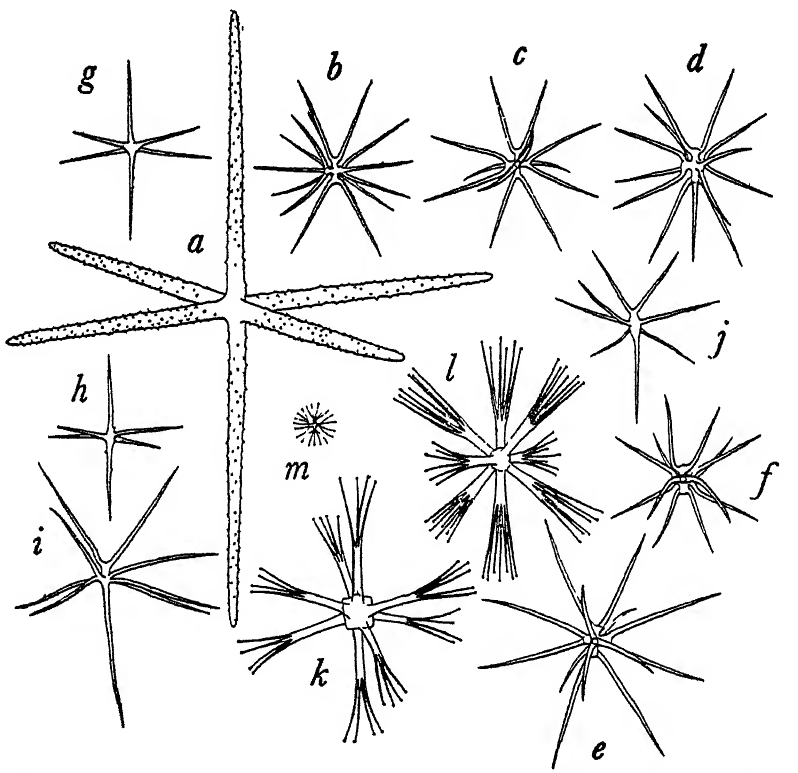


FIGURE 15.—*Rhabdocalyptus heteraster*, new species: *a*, Gastral hexactin, × 225; *b*, oxyhexaster (form B), × 270; *c*, oxyhexaster (form B), × 270; *d*, oxyhexaster (form C), × 270; *e*, oxyhexaster (form A), × 270; *f*, oxyhexaster (form C); × 270; *g*, hexactinic form, × 270; *h*, hexactinic form, × 270; *i*, hemihexactinic form, × 270; *j*, hemihexactinic form, × 270; *k*, discoctaster, × 270; *l*, discoctaster, × 180; *m*, microdiscohexaster, × 270

them are fairly thin-walled, subglobular, and purselike in form, and are without a specially formed attachment at the base. In the larger one (holotype, U.S.N.M. No. 22052) the total height is 85 mm

and the breadth 57 mm measured at the broadest part, which is just above the middle of the entire stock. The smaller one is 20 mm in height and 12 mm in breadth. The dermal surface is rough and is covered with pentactinic pleuralia on the inferior parts of the sponge body. The oscular margin is much injured, only a part remains of one side and it seems not to flare out. The orifice is subcircular, with a thin edge. The incurrent canalar apertures are very small, attaining a size of nearly 0.5 mm and becoming smaller toward the upper region of the sponge; they are numerous and distributed closely together. The excurrent canalar apertures are also small, nearly the same size as those of the incurrent canalar apertures, covered by the thin gastral layer. The thickness of the wall near the basal region is 3 mm to 4 mm, which becomes thinner toward the oscular edge.

Spiculation.—Parenchymalia are long diactins, wholly smooth on the center and roughened or microspined toward the ends, with sharply pointed or conically pointed ends. The slenderer ones are in bundles, and the thicker are isolated.

Hypodermal oxypentactins with the paratangential rays are paratropal, more or less curved, smooth, and provided with nearly regularly distributed. sharply pointed thorns.

Dermalia are rough pentactins, occasionally hexactins, or rarely stauractins. The rays average 115μ long, measured from the center, and 12μ thick. They taper outward to a slight degree; the ends are rounded or conically pointed. The paratangential cross is usually not convex on the outside and measures 220μ to 240μ in length. Seen surface on, the delicate dermal latticework presents irregular meshes, though in places these show a tendency to assume a regular quadrate arrangement, measuring 130μ in length of sides. The hexactins and stauractins are of usual appearance and have nearly the same length of ray, 100μ to 150μ long. The latter spicules seem to be more abundant than the former.

The gastralia are chiefly hexactins (fig. 15, *a*). The rays are similar to those of the dermalia; only they are usually of a much greater dimension. The paratangentials are somewhat longer than the distal ray, measuring 120μ to 135μ in length, though they are much shorter than the proximal ray, which may attain a length of 170μ. The rays are 10μ thick at the base and taper somewhat strongly outward to sharply or conically pointed ends. Except for the central node, all surfaces of the rays are microspined, though more sparsely proximally.

Three varieties of oxyhexasters may be distinguished, designated by letters A, B, and C.

The first oxyhexaster, form A (fig. 15, *e*), occurs mostly in the ectosome and occasionally intermixed with form C in the choano-

some; diameter, 105μ. The principal is exceedingly short and slender and to it two slender terminals (occasionally three) are usually attached. They are nearly straight, narrowly diverged, and slightly rough, or nearly smooth on the surface.

The second variety, form B (fig. 15, *b*, *c*), is nearly the same size as form A, but is frequently smaller. It occurs mostly in the choanosome, rarely intermixed with the form A in the dermal layer. It is distinguished by slender principals and by weakly bifurcated slender terminals. (The degree of divergence is about intermediate between forms A and C.) Each short, slender, principal is provided with two straight, smooth terminals, and does not form a central node, as in form A.

The last oxyhexaster, C (fig. 15, *d*, *f*), occurring only in the gastral layer, measures 76μ in diameter. It is distinguished by having very broad principals, forming a distinct central node, and widely diverging terminals. Each broad principal in a spicule usually carries two of these widely diverging, smooth terminals.

Besides these normal oxyhexasters, there are hemihexactinic (fig. 15, *i*, *j*) and hexactinic (fig. 15, *g*, *h*) forms in the parenchymal, subdermal, and subgastral layers. They measure about 80μ in axial length and have smooth-surfaced rays.

The microdiscohexaster (fig. 15, *m*) is present sparsely in the gastral layer and near the hypogastral layer. It measures 20μ in diameter and is provided with very delicate terminals. As its features are common to the microdiscohexaster, which occurs in many members of the present genus, a detailed description here is unnecessary.

Discoctasters occur in abundance everywhere in the entire body. Of them I also distinguish two varieties. They occur in different quantities and show also certain differences in the manner of distribution and in shape. The one variety (fig. 15, *l*) usually occurs in the subdermal space and is much larger than the other. In diameter the spicule in question varies from 190μ to 290μ. The central node frequently has six more or less distinct hillocklike prominences. The principals take up about one-third or less of the entire ray length, measuring 32μ long, while the terminals are nearly twice as long as the principals. There are five to eight terminals in a tuft; occasionally as few as three. The tuft is very gently expanded distally, the terminals composing it being each slightly bent outward, or are sometimes nearly straight. The surface of the terminals and principals is smooth or microtuberculated. The terminal disks are very small and pinheadlike.

The other form (fig. 15, *k*) resembles that occurring in *Rhabdocalyptus dawsonii*. It is usually present in the subgastral and parenchymal regions; frequently in the subdermal space intermingled with the former variety. It is much smaller, averaging 90μ in

diameter, with a distinct, quadrangular central node, which is 8μ to 10μ across.

The principals are slender and smooth on the surface. They are much shorter, about half or more of the length of the terminals, which measure about 16μ long. There are two to four terminals to each principal. The tuft is also gently curved near the end. The terminal disks are also much smaller and are pinheadlike in shape.

Remarks.—The distinguishing characters of the present species are: (1) Two kinds of discoctaster are present; the larger one measures 190μ to 210μ in diameter and is not provided with a distinct quadrangular central node, while the smaller one measures 90μ and has a very regular, quadrangular central node. (2) There are three kinds of normal oxyhexasters, differing in dimensions, in degree of divergence of the terminals, and in the development of the principals.

RHABDOCALYPTUS AUSTRALIS Topsent

Rhabdocalyptus australis TOPSENT, Result. Voy. S. Y. *Belgica*, Zoologie, Spongiaires, p. 37, pl. 2, figs. 5, 6, pl. 4, figs 14–21, pl. 5, fig. 1, 1901.

Two complete specimens were obtained from the same station, together with *Rhabdocalyptus borealis.* Specimen A is larger than B, and is an elongate, tubular, or vaselike sponge, slightly and irregularly compressed laterally. It is about 68 mm long, 19 mm broad in the middle, and considerably tapered at the lower end, which measures 13 mm broad. The upper truncated end of the body is occupied by an oval-shaped osculum, measuring 10 mm in diameter. The wall is about 2 mm thick in the middle, gradually becoming thinner toward the oscular edge, and is thinner than that of the second specimen. Over the entire external surface, except near the inferior part of the stock, there arise pentactinic prostal pleuralia. In the upper part of the body they are finer and much shorter than those situated lower down. Along the oscular edge the diactinic prostal marginalia project straight upward, the exposed portion attaining a length of 7 mm.

Specimen B is very small, measuring about 13 mm in diameter. It retains a barrellike shape, a cross-section of the body being approximately circular. It possesses a small circular osculum 4 mm in diameter. The body wall is very thick, attaining a thickness of 4 mm at the thickest part of the body. Both the prostal marginalia and

TABLE 23.—*Record of specimens of* Rhabdocalyptus australis

Specimen	Collected at—	Number and description
A	Station 4772, Bowers Bank, Bering Sea, 344 fathoms	One, large, completely preserved.
B	do	One, small, complete

the prostal pleuralia have increased in number. The latter are abundant over the entire stock.

Spiculation.—The diactinic prostal marginalia are very long, measuring 15 mm to 20 mm, and are inserted over half or more of the entire length. They measure 132μ to 176μ in diameter in the middle and are gradually tapered at both ends. They are smooth on the surface, except at both ends, which are usually minutely tuberculated, although occasionally not tuberculated in the larger specimen. Prostal basalia have a shape somewhat different from the other prostal marginalia and prostal pleuralia. They measure 0.132 mm to 4.79 mm in length and 22μ diameter in the middle. They are slightly narrowed proximally, but become broad distally, usually forming a distinct knob-shaped swelling. Both ends are strongly tuberculated.

The discoctaster is rare. The microdiscohexaster may be lacking.

RHABDOCALYPTUS UNGUICULATUS Ijima

Rhabdocalyptus unguiculatus Ijima, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 18, art. 7, pp. 268–276, pl. 21, figs. 1–12, 1904.

This species is represented by two specimens obtained from a depth of 482 fathoms near the western extremity of the Aleutian Islands (Station 4781). It has hitherto been recorded from the Sagami Sea in Japan, and this is the first time it has been collected so far north. The smaller specimen (A) differs a little from *R. unguiculatus*, but I am nevertheless inclined to identify it with that species. It is almost completely preserved, lacking only the basal parts of the stock. It is vaselike in form, 125 mm in height and 50 mm broad in the middle. The thickness of the wall at this point is 6 mm to 7 mm. The osculum is smaller than that of the type species, measuring 11 mm in size. The gastral latticework, however, is discontinuous. Its meshes are not vaulted, and, being filled with the choanosome, are not visible to the eye.

Spiculation of specimen A.—The discoctasters have much smaller dimensions, in diameter measuring 108μ to 140μ. I have even seen a few of them outside of the dermal layer. One point of difference from the type specimens is that they probably occur in two very slightly differing sizes, the one chiefly in the hypodermal and hypogastral layers and the other in the parenchymal space. The hypodermal and hypogastral discoctasters are slightly larger than the latter, measuring 135μ to 140μ in diameter. The central node arising from the principals is very prominent. The parenchymal discoctasters measure 108μ to 112μ in diameter and infrequently the central node is indistinct. In general, the terminals of the oxyhexaster are much more fragile and slightly more wavy than those of the type specimens.

Specimen B is not so well preserved as specimen A; several parts of the entire stock are torn off. The hypodermal pentactins are more numerously veiled on the surface of the sponge. In this specimen, the prostal marginalia are better developed and can be distinctly observed. Along the oscular edge the diactinic prostal marginalia project straight upward, the exposed portion attaining a length of 30 mm. This spicule is very long, and is inserted for half or more of its entire length in the sponge body. They are smooth on the surface except the proximal ends, which are minutely tuberculated and taper gradually toward the tips. In the discoctasters, the humplike prominences of the central node usually appear and are distinctly recognizable. The terminals of the oxyhexasters are not so fragile as those occurring in specimen A and are very nearly like those of the type specimens.

RHABDOCALYPTUS BIDENTATUS, new species

FIGURE 16

This new species is based on a single holotype specimen (United States National Museum No. 22053). It is a fairly large, solitary individual, obtained at Station 5087 in Sagami Bay (614 fathoms). The body is cuplike in shape, truncated at the upper end and gradually narrowed toward the base. The height is 195 mm. The body is only slightly laterally compressed. At the superior region of the body the breadth is 95 mm; near the base it is 45 mm. The oscular edge is not so thin as in some other members of the genus and may not be provided with distinct prostal marginalia. The base is solid, as the gastral cavity does not extend to the attachment surface. The thickness of wall at the middle of the body is 10 mm; farther below it measures up to 2 mm and near the oscular margin it measures 7 mm. The dermal surface may be fairly smooth, when in a good state of preservation. On the whole, it forms a delicate lacework, judged from the remains of the meshes of latticework seen under the microscope. Pentactinic hypodermalia are mostly preserved in inferior parts of the stock. On the inner side of the wall, the endosome shows a continuous delicate gastral lacework, the quadrate meshes of which are visible to the naked eye.

The incurrent canalar apertures are of about the same size as the excurrent on the external side but are somewhat more closely set together. They usually show an oval, sometimes elliptical, shape and measure 2 mm to 7 mm.

Our species closely resembles *R. unguiculatus* Ijima but differs from it chiefly in the dermal spiculation and in the character of the terminal disk of the discoctaster, which has two distinct sharply pointed claws on its edge. The species also agrees with *R. mirabilis*

Schulze in essential characters, but differs from it in the character of the gastral hexactins and of the discoctasters, the latter differing in the same manner as those of *R. unguiculatus* just mentioned.

Spiculation.—The principal parenchymalia are mainly slender oxydiactins (fig. 16, *d*), attaining a length of 6 mm and a thickness of 8μ to 20μ at the middle. They usually form slender bundles,

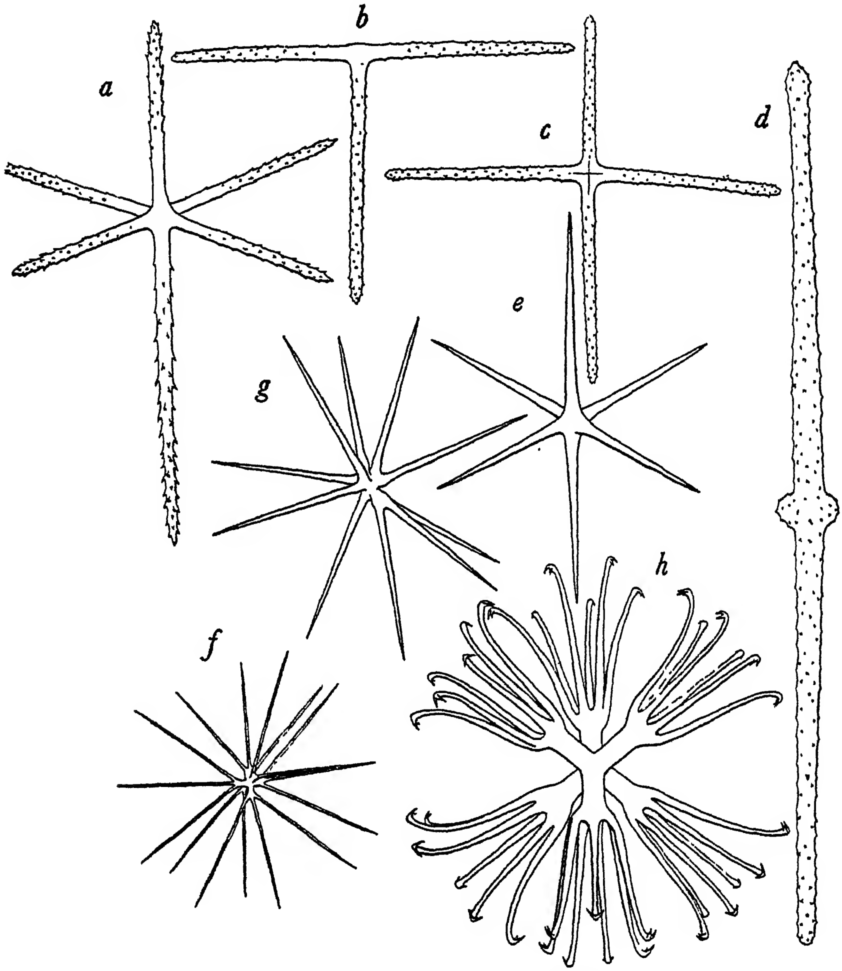


FIGURE 16.—*Rhabdocalyptus bidentatus*, new species: *a*, Gastral oxyhexactin, × 175+; *b*, dermal tauractin, × 157+; *c*, dermal stauractin, × 175+; *d*, parenchymal diactin, × 375; *e*, hexactinic form, × 375; *f*, oxyhexaster, × 375; *g*, hemihexactinic form, × 375; *h*, discoctaster, × 375

although they occasionally appear singly. The gradually tapering rays are subterminally more or less rough. There are no points worth special mention regarding the slenderer parenchymalia.

The hypodermalia consist of large oxypentactins with paratropal paratangentials, which are 5 mm to 6 mm in length and about 80μ

in thickness at the base. The shaft, up to 6.5 mm to 7 mm in length, is always the longest of the rays; it is smooth except at the roughened end and is not provided with spines. The paratangentials are also nearly smooth on the surface. The stout conical spines occur in a rather regular distribution—in two lateral rows. Those situated on the basal parts of the rays spring vertically, become more or less bent forward near the end of the ray, and bend more strongly toward the extremity. These hypodermal pentactinic spicules may occur singly and not in close groups of two or more, as in some other members of this genus. Occasionally they occur fairly close together. Diactins do not seem to associate with the hypodermal paratangentials in forming the support to the dermal layer.

The dermalia are mostly stauractins (fig. 16, *c*), but frequently rough diactins and rarely pentactins, as well as stauractins. The common stauractins appear abundantly in the entire stock. The center of these is generally plain but occasionally shows a gentle swelling on either the external or the internal side or both. The axial length of the spicule may measure 260μ to 320μ and 10μ thick at the center. The entire surface is slightly roughened, being more pronounced at the conically pointed ends. In the diactins the suppressed rays are indicated by three knobs in a cruciate arrangement on the center. The rays are rough all over and taper slightly toward the rounded or obtusely conical end. They measure 320μ to 480μ in total length and 12μ in thickness near the middle. In the tauractins (fig. 16, *b*) the atrophied paratangential usually leaves a knoblike relic, while the radial rays may or may not be similarly represented. The meshes of the dermalia, which are composed of stauractins, diactins, and pentactins, are more irregular in shape than those of the gastralia.

The gastralia are rough oxyhexactins (fig. 16, *a*) of great axial length. The length of the free proximal ray in the most prominent part is 320μ; that of the distal ray, 160μ; that of the paratangentials, 180μ; thickness of rays near the base, about 10μ on the average. The microtubercles on all rays are sparsely and uniformly developed but are somewhat strongly pronounced on all the ends. The gastral lacework shows a regular quadrangular shape, measuring about 140μ by 190μ in length of sides.

The discoctasters (fig. 16, *h*) resemble in shape and size those of *R. unguiculatus*. They are found more abundantly in the ectosome, as well as directly under the dermalia, than in deeper parts. Their diameter is 150μ to 160μ. The principals are entirely smooth on the surface and 16μ long as measured from the spicular center; in any case they are much longer than in *R. unguiculatus*. The terminals number 6 to 8 to each principal and form a rather broad, lilylike tuft, expanded at the outer end. Each terminal disk distinctly shows

strongly recurved and sharply pointed marginal claws, usually numbering two, occasionally three or more, on the external side of the disk.

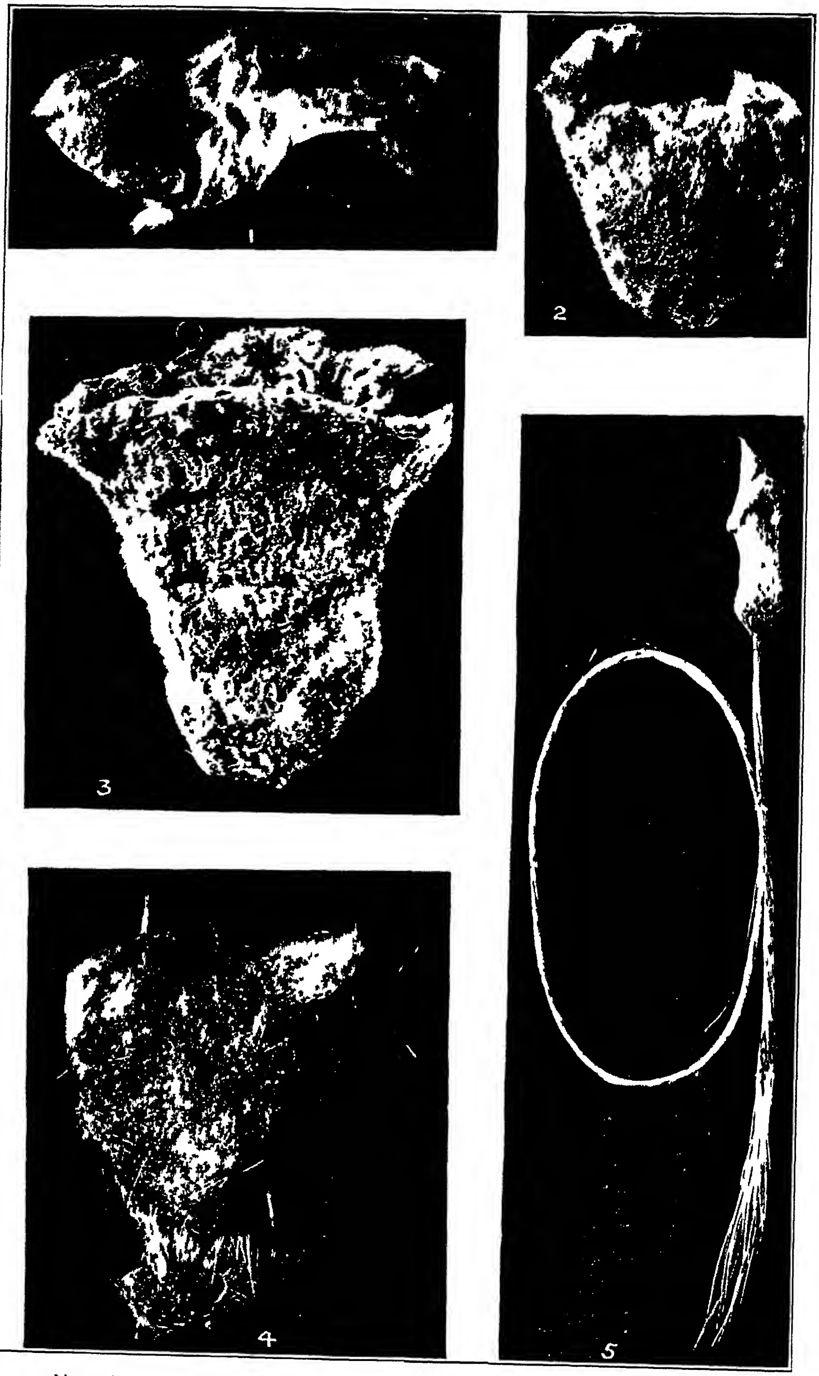
Oxyhexasters represented by hemihexactinic and somewhat less frequently by hexactinic forms, are abundantly present in the choanosome as well as in the gastral layer. Normally developed oxyhexasters (fig. 16, *f*) may frequently appear in the choanosome, measuring 130μ to 140μ in diameter. From each exceedingly short principal there diverge two, occasionally three, slightly rough-surfaced and nearly straight terminals. Hexactinic forms (fig. 16, *e*) (axial length 120μ) are for the most part appreciably smaller than the hemihexactinic. It seems to be the general rule that the oxyhexasters show a tendency to take the hexactinic form. The terminals appear to be moderately thin and are generally nearly straight. In the hemihexactinic forms (fig. 16, *g*) usually five, but sometimes one, of the six principals are uniterminal; the rest of the principals are biterminal, in which case the entire ray is either straight or else is bent at the base. A case of a principal bearing more than two terminals has not been observed.

Microdiscohexasters of 30μ and 40μ in diameter are sparsely distributed in the dermal membrane as well as in the choanosome. They are quite similar to those occurring in *R. unguiculatus*, except in having a greater diameter.

RHABDOCALYPTUS VICTOR Ijima

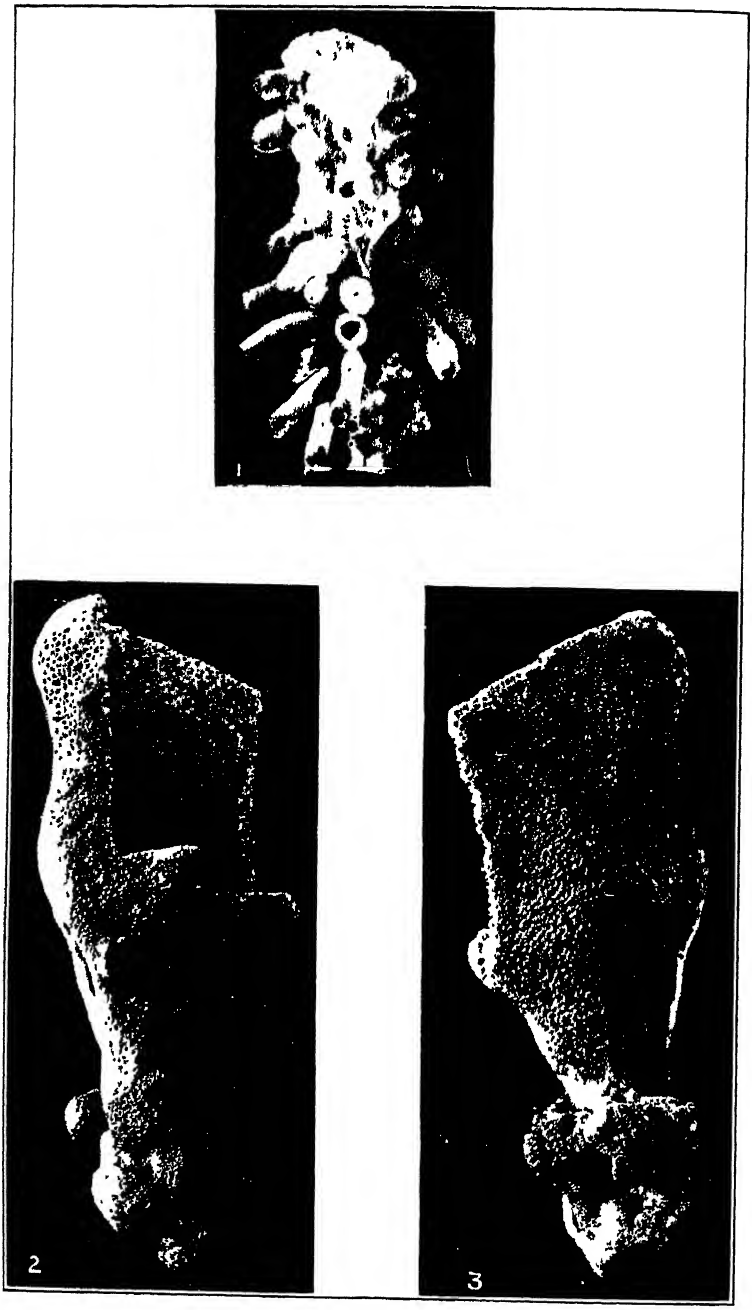
Rhabdocalyptus victor IJIMA, Annot. Zool. Japon., vol. 1, p. 52, 1897.—CH. GRAVIER, Bull. Mus. d'Hist. Nat. Paris, vol. 5, no. 8, p. 421, 1899.—IJIMA, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 18, art. 7, pp. 238–253, pls. 18, 19, figs. 1–23, 1904.

Two small fragments in this collection, which probably belong to the same colony, were obtained at the entrance of the Uraga Channel, at a depth of 200 fathoms (Station 5090). In these specimens I found much larger and stronger parenchymal prostalia than any hitherto recorded, attaining a length of 30 mm to 40 mm and a width of 170μ at the middle. The discoctaster usually measures 180μ in diameter, and frequently larger ones, measuring 220μ in diameter, are found on the gastral layer intermingled with the smaller. It may be somewhat worth while to mention that the meshed siliceous reticulum, which seems to be homologous to that of basidictyonal plate in its contitution and formation, is occasionally present on the surface of the large parenchymal diactins to which it is attached. The foundation of this network is made up of certain stauractins, hexactins, and pentactins, synapticularly fused together.



NEW SPECIES AND SUBSPECIES OF HYALONEMA AND PHERONEMA

1, 2, *Hyalonema (Cyliconema) apertum solidum*; 3, 5, *H. (C.) hozawai*; 4, *Pheronema globosum kagoshimensis*. All about natural size except 5, which is $\times \frac{2}{3}$.

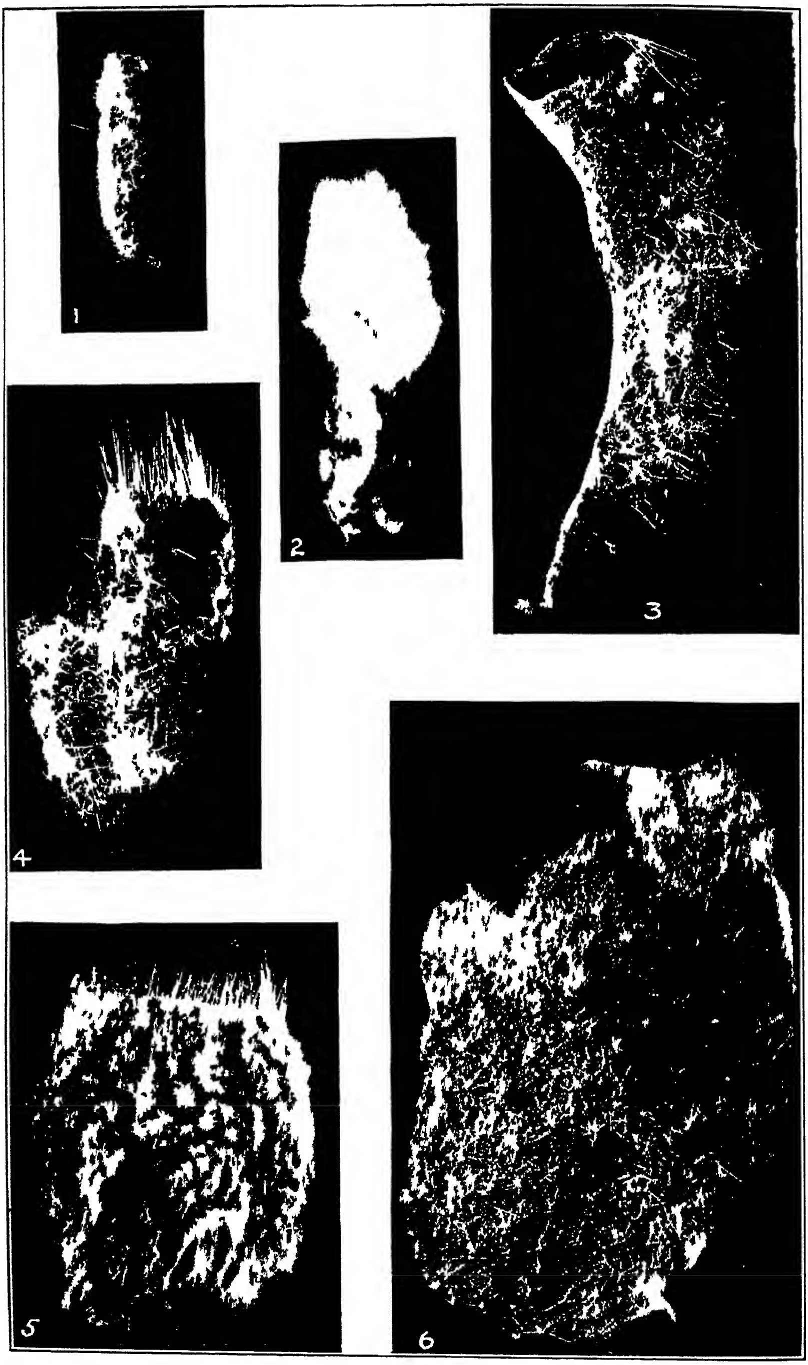


APHROCALLISTES

1, *Aphrocallistes beatrix orientalis* Ijima. 2, 3, *A. yatsui*, new species. All natural size.

ACANTHASCUS, LANUGINELLA, AND AULOSACCUS

1, *Acanthascus pachyderma*, new species, × 1. 2, *Lanuginella pupa* Schmidt, × 1. 3, *Aulosaccus albatrossi*, new species, × 1/3. 4, *A. pinularis*, new species, ×



NEW SPECIES OF RHABDOCALYPTUS BATHYDORUS STAUROCALYPTUS AND HYALASCUS

1 *Phabdocalyptus bidentatus* 2 *Bathydorus* a species 3 *Rhabdocalyptus borealis* 4 *Staurocalyptus rugocruciatus* 5 *Hyalascus attenuatus* 6 *Rhabdocalyptus heteraster* All about natural size except 2 which is × 3

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(Synonyms are given in *italics*)

O

THE TREMATODE PARASITES OF MARINE MAMMALS

BY

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1932

THE TREMATODE PARASITES OF MARINE MAMMALS

By Emmett W. Price

Parasitologist, Zoological Division, Bureau of Animal Industry
United States Department of Agriculture

The internal parasites of marine mammals have not been extensively studied, although a fairly large number of species have been described. In attempting to identify the trematodes from mammals of the orders Cetacea, Pinnipedia, and Sirenia, as represented by specimens in the United States National Museum helminthological collection, it was necessary to review the greater part of the literature dealing with this group of parasitic worms. In view of the fact that there is not in existence a single comprehensive paper on the trematodes of these mammals, and that many of the descriptions of species have appeared in publications having more or less limited circulation, the writer has undertaken to assemble descriptions of all trematodes reported from these hosts, with the hope that such a paper may serve a useful purpose in aiding other workers in determining specimens at their disposal.

In addition to compiling the descriptions of species not available to the writer, two new species, one of which represents a new genus, have been described. Specimens representing 10 of the previously described species have been studied and emendations or additions have been made to the existing descriptions; in a few instances the species have been completely redescribed.

Three species, *Distomum pallassii* Poirier, *D. validum* von Linstow, and *D. ampullaceum* Buttel-Reepen, have been omitted from this paper despite the fact that they have been reported from cetaceans. These species belong in the family Hemiuridae, and since all species of this family are parasites of fishes, the writer feels that their reported occurrence in mammals may be regarded as either errors of some sort or cases of accidental parasitism in which fishes have been eaten by mammals and the fish parasites found in the mammal post-mortem. Buttel-Reepen (1902) has pointed out, in connection with the reported occurrence of *D. ampullaceum* in a cetacean, that sailors commonly designate species of mackerel as "Delphin" or "Dolphyn (holländisch)." It appears likely, there-

fore, that in this case these terms for fishes have been interpreted to mean a dolphin and that these fish parasites have been erroneously listed as parasites of cetaceans.

In the compiled descriptions all measurements when less than 1 mm have been given in microns, when more than 0.5μ the fraction has been counted as 1μ, and if less the fraction has been discarded.

The trematodes of marine mammals which may be considered valid or recognizable forms comprise 30 species belonging to nine families: Fasciolidae Railliet, Echinostomatidae Looss, Troglotrematidae Odhner, Opisthorchiidae Braun, Heterophyidae Odhner, Paramphistomatidae Fischoeder, Notocotylidae Lühe, Opisthotrematidae Poche, and Rhabdiopoeidae Poche. These families may be differentiated by the following key:

KEY TO FAMILIES OF TREMATODE PARASITES OF MARINE MAMMALS

1. Body provided with two suckers; eggs without polar filaments ---- 2
   Body provided with only one sucker; eggs with polar filaments ---- 7.
2. Acetabulum or ventral sucker situated at posterior end of body. **Paramphistomatidae** (p 41).
   Acetabulum situated in anterior half of body ---- 3.
3. Anterior end of body provided with a kidney-shaped collar armed with one to two rows of large spines ---- **Echinostomatidae** (p. 21).
   Anterior end of body without collar as above ---- 4.
4. Usually large flukes, either flat and leaflike, slightly flattened, or cylindrical; cirrus pouch and cirrus present; seminal receptacle very small or absent ---- **Fasciolidae** (p. 3).
   Medium-sized to very small flukes, usually oval and flattened; cirrus pouch and cirrus absent; seminal receptacle large and conspicuous ---- 5.
5. Body spindle shaped; occurring in cysts, usually in pairs. **Troglotrematidae** (p. 23).
   Body flat, not occurring in cysts ---- 6.
6. Body covered with small, scalelike spines; acetabulum inclosed in the genital sinus; parasites of the intestinal tract. **Heterophyidae** (p. 33).
   Body usually without spines; acetabulum not inclosed in the genital sinus; parasites of the gall bladder or bile ducts. **Opisthorchiidae** (p. 25).
7. Genital pore situated at extreme posterior end of body. **Opisthotrematidae** (p. 48).
   Genital pore near anterior end of body ---- 8.
8. Ventral surface of body usually provided with longitudinal rows of glands, or rugae; vitellaria pretesticular; without proboscid complex in posterior part of body ---- **Notocotylidae** (p. 44)
   Ventral surface of body without rows of glands, or rugae; vitellaria posttesticular; proboscid complex in posterior part of body ---- **Rhabdiopoeidae** (p. 47).

Family FASCIOLIDAE Railliet, 1895

Synonyms.—Fasciolopsidae Odhner, 1926, p. 4; Campulidae Odhner, 1926, p. 5; Brachycladiidae Faust, 1929, p. 88.

Family diagnosis.—Large flat forms; suckers relatively close together; cuticle with or without spines. Intestinal ceca simple or with lateral dendritic branches. Excretory bladder simple and tubelike, or profusely branched. Genital pore preacetabular; cirrus pouch present; cirrus armed or unarmed. Testes usually profusely branched, but may be without branches or lobes. Ovary branched or entire; seminal receptacle reduced or absent; Laurer's canal present. Vitellaria profusely developed, consisting of numerous follicles situated along the sides of the body and becoming confluent posteriorly. Uterus with relatively few coils; eggs large, either circular or triangular in cross section.

Type genus.—*Fasciola* Linnaeus, 1758.

KEY TO SUBFAMILIES OF FASCIOLIDAE CONTAINING SPECIES PARASITIC IN MARINE MAMMALS

1. Body flat, leaflike; testes and ovary profusely branched; eggs without thickening at posterior pole, circular in cross section. **Fasciolinae** (p. 3).

   Body elongated and slightly flattened, but not leaflike; testes and ovary usually unbranched; eggs with thickening at posterior pole, usually triangular in cross section______ **Campulinae** (p. 5).

Subfamily FASCIOLINAE Stiles and Hassall, 1898

Subfamily diagnosis.—Fasciolidae: Body flat and leaflike. Intestinal ceca profusely branched, the branches being dendritic and mainly lateral. Excretory vesicle with lateral branches. Testes profusely branched; cirrus pouch not extending beyond posterior margin of acetabulum; cirrus unarmed. Ovary branched. Eggs without thickening at posterior pole, circular in cross section. Parasites of herbivorous or omnivorous mammals.

Type genus.—*Fasciola* Linnaeus, 1758.

Genus FASCIOLA Linnaeus, 1758

Generic diagnosis.—Fasciolinae: Body large, broad, flat, and leaflike; anterior end conical, forming a cephalic cone, which is set off from the wider, flattened, leaflike portion. Cuticle armed with scalelike spines. Oral sucker subterminal; acetabulum at base of cephalic cone. Prepharynx short; pharynx well developed; esophagus short; intestinal ceca long, extending to posterior end of body and provided with numerous, long, dendritic lateral branches, and fewer, shorter,

median branches. Excretory vesicle long and slender, with numerous lateral branches, which anastomose to form an extensive dorsal and ventral network. Genital pore preacetabular, situated at base of cephalic cone; cirrus pouch not extending caudally beyond posterior margin of acetabulum; testes profusely branched, tandem in position, and situated in the equatorial zone. Ovary branched, pretesticular, situated to one side of median line; seminal receptacle absent; Laurer's canal present. Vitellaria very profusely developed, extending from base of cephalic cone to posterior end of body, completely filling posttesticular area, and extending both dorsal and ventral to intestinal ceca. Uterus coiled in the form of a rosette, situated between acetabulum and ovary. Eggs large, without thickening of posterior pole, circular in cross section. Parasitic in bile ducts of herbivorous and omnivorous mammals.

Type species.—*Fasciola hepatica* Linnaeus, 1758.

FASCIOLA HEPATICA Linnaeus, 1758

PLATE 1, FIGURE 1

Synonyms.—*Planaria latiuscula* Goeze, 1782, p. 169; *Distoma hepaticum* (Linnaeus, 1758) Abildgaard (?); *Fasciola humana* Gmelin, 1790, p. 3053; *Fasciolaria hepatica* Encycl. Metropolitana, 1845, p. 141; *Distomum caviae* Sonsino, 1890, p. 100; *Cladocoelium hepaticum* (Linnaeus, 1758) Stossich, 1892, p. 7.

Description.—*Fasciola:* Body flat and leaflike, 13 mm long by 3.7 mm wide in region of ovary; cephalic cone 1 mm long. No cuticular spines were present on the specimen examined by the writer. Oral sucker subterminal, 387μ long by 542μ wide; acetabulum transversely oval, 542μ long by 697μ wide, situated 1.2 mm from anterior end of body. Digestive tract as described for *F. hepatica* by other writers. Testes profusely branched, occupying the entire intercecal field from the level of the ovary to about one-fourth of the body length from the posterior end. Cirrus pouch ovoid, not extending caudad beyond center of acetabulum; cirrus strongly muscular, not protruded. Ovary branched, situated to right of median line immediately cephalad of testis; Mehlis's gland globular, 341μ in diameter, situated in median line. Vitellaria profusely developed, extending to level of acetabulum on the right side, but stopping abruptly about 1 mm caudad of acetabulum on the left side; caudally the vitelline follicles completely fill the posttesticular area. Uterus closely coiled and occupying the intercecal field between the anterior testis and acetabulum; genital pore 186μ cephalad of anterior margin of acetabulum. Eggs oval, 120μ to 127μ long by 60μ to 67μ wide.

Hosts.—Herbivorous mammals and man; marine mammals (*Orcinus orca*=*Orca gladiator; Balaenoptera acutorostrata*=*B. rostrata*).

Location.—Bile ducts for marine mammals, and usually for other animals.

Distribution.—Europe (for *B. acutorostrata* and *Orcinus orca*).

Remarks.—The description of *Fasciola hepatica* given here is based upon a carmine-stained toto mount, which Dr. C. W. Stiles kindly loaned the writer for study, it being one of the specimens referred to below. Aside from a few slight differences, such as body size and a slightly smaller egg, this fluke so closely resembles *F. hepatica* from ruminants that it must be regarded as the same species.

There appear to be only two records of *Fasciola hepatica* from marine mammals. Stiles and Hassall (1894) record this species from *Orca gladiator*, and later Stiles (1894, p. 302) states: "Leuckart once gave me two specimens of a fluke, which I still have in my possession, labeled 'Leber, Schwert-fisch.' I am unable to distinguish this fluke from *Fasciola hepatica.* I assume that this 'Schwert fish' is *Orca gladiator* rather than *Xiphias gladius*, as all the other hosts of *F. hepatica* are mammals." Odhner (1905) notes that he found a fragment of *F. hepatica* in a vial labeled "*Distoma goliath* van Ben.," in the Kopenhagen Museum. Odhner believed that this was a case of mislabeling and regarded it as unthinkable that a whale could have become infested with this fluke.

The two records cited above may have been the result of mislabeling, but if so it is quite remarkable that two such instances should have occurred in which the hosts cited were cetaceans.

Subfamily CAMPULINAE Stunkard and Alvey, 1930

Synonym.—Brachycladiinae Odhner, 1910c, p. 165.

Subfamily diagnosis.—Fasciolidae: Elongated, medium-sized to very large flukes; body relatively narrow and thick. Cuticle armed with relatively large, pointed spines. Suckers close together in some genera and rather widely separated in others. Digestive system H shaped, except in *Odhneriella;* anterior ceca short; posterior ceca long, sinuous and extending to posterior end of body; diverticula, when present, are both median and lateral. Excretory vesicle tubelike, without lateral branches. Genital aperture preacetabular; cirrus pouch frequently extends far caudad of acetabulum; cirrus armed or unarmed. Testes slightly or deeply lobed, or smooth, tandem in position, and situated not far caudad of ovary. Ovary smooth or slightly lobed; seminal receptacle much reduced in size or absent; Laurer's canal present. Vitellaria well developed. Uterus with relatively few loops; vagina with or without spines. Eggs with thickened posterior pole, usually triangular in cross section. Parasites of marine mammals.

Type genus.—*Campula* Cobbold, 1858.

KEY TO THE GENERA OF THE SUBFAMILY CAMPULINAE

1. Cirrus unarmed ---- 2.
   Cirrus armed ---- 4.
2. Body slender, 60 mm to 80 mm long; ovary deeply lobed; vitellaria in more or less rectangular masses of follicles ---- Lecithodesmus (p. 11).
   Body more robust, less than 20 mm long; ovary not lobed; vitellaria not as above ---- 3.
3. Oral sucker much larger than acetabulum; eggs circular in cross section ---- Zalophotrema (p. 13).
   Oral sucker and acetabulum about equal in size; eggs triangular in cross section ---- Campula (p. 6).
4. Vagina unarmed; vitelline follicles in distinct masses ---- 5.
   Vagina armed; vitelline follicles not in distinct masses ---- 6.
5. Anterior ceca absent; in liver of pinnipeds ---- Odhneriella (p. 20).
   Anterior ceca present; in intestine of cetaceans ---- Hadwenius (p. 17).
6. Testes deeply lobed; intestinal ceca with median and lateral diverticula ---- Synthesium (p. 16).
   Testes not deeply lobed; intestinal ceca without median and lateral diverticula ---- Orthosplanchnus (p 14).

Genus CAMPULA Cobbold, 1858

Synonym.—*Brachycladium* Looss, 1899, p. 558.

Generic diagnosis.—Campulinae: Body elongated and slightly flattened; posterior end usually more pointed than anterior end. Cuticle completely covered with large, pointed spines. Oral sucker slightly smaller than acetabulum. Intestinal ceca with short median and lateral diverticula. Excretory vesicle tubelike, extending anteriorly to ovary. Genital pore immediately cephalad of acetabulum; cirrus pouch short; cirrus unarmed; testes with or without lobes, never dendritic. Ovary entire, pretesticular; seminal receptacle reduced; Laurer's canal present. Vitellaria profusely developed, extending anteriorly to level of pharynx. Uterus with few coils. Eggs triangular in cross section.

Type species.—*Campula oblonga* Cobbold, 1858.

KEY TO SPECIES OF THE GENUS CAMPULA

1. Testes lobed ---- 2.
   Testes not lobed ---- 3.
2. Cirrus pouch not extending caudad of acetabulum; intestinal branches without anal openings ---- palliata (p. 9).
   Cirrus pouch extending caudad of acetabulum; intestinal branches with anal openings ---- oblonga (p. 7).
3. Suckers close together; testes preequatorial ---- rochebruni (p. 11).
   Suckers widely separated; testes in posterior third of body ---- delphini (p. 9).

CAMPULA OBLONGA Cobbold, 1858

PLATE 1, FIGURES 2–5

Synonyms.—Distomum oblongum (Cobbold, 1858) Braun, 1892, p. 99; *Distomum* (*Brachylaimus*) *oblongum* (Cobbold, 1858) Stossich, 1892, pp. 16–17; *Brachycladium oblongum* (Cobbold, 1858) Looss, 1902, p. 716; *Distomum tenuicolle* Rudolphi of Olsson, 1893, p. 9.

Description.—Campula: Body elongate, 4 to 7 mm long by 1 to 3 mm wide, anterior end obtuse, posterior end rounded. Cuticle armed with pointed spines, 44μ long by 14μ wide, arranged in alternating transverse rows. Oral sucker subterminal, 310μ to 340μ in diameter; acetabulum 430μ to 465μ in diameter, situated a little less than one-fourth of the body length from the anterior end. Prepharynx very short and wide; pharynx piriform, 310μ to 360μ long by 170μ to 220μ wide; esophagus about 100μ long. The short, anteriorly directed, intestinal ceca extend beyond posterior margin of the oral sucker and are not provided with lateral diverticula; the posteriorly directed branches are more or less zigzag and extend to the posterior end of the body, where they open into a depression in common with the excretory vesicle; the posterior branches of the intestine are provided with short median and lateral diverticula. The excretory vesicle is tubelike and extends anteriorly, dorsal to testes, to the level of the posterior margin of the ovary; it is slender at the posterior end, but becomes progressively wider anteriorly. The genital aperture is situated immediately cephalad of the acetabulum; genital sinus small. Cirrus pouch somewhat pestle shaped, slightly curved, and extending caudad to a point about midway between the posterior margin of acetabulum and the anterior margin of ovary. The greater part of the cirrus pouch is filled with a sinuous seminal vesicle. Cirrus unarmed, protrusible. The testes are deeply lobed, tandem in position, and occupy the equatorial third of the body; the anterior testis is 620μ to 770μ long by 770μ to 990μ wide, and the posterior testis in 620μ to 1 mm long by 770μ to 1.2 mm wide. Ovary transversely oval, 186μ to 372μ long by 310μ to 527μ wide, situated immediately cephalad of anterior testis and to the right of the median line. Seminal receptacle greatly reduced in size or (?) absent (Nicoll described a small seminal receptacle, but the writer has been unable to demonstrate this structure in the specimens at his disposal); Laurer's canal present. Vitellaria abundantly developed, the follicles being distributed over the entire dorsal surface from the level of the posterior end of the esophagus to the posterior end of body; ventrally

the follicles do not extend medially much beyond the inner limits of the intestine in the testicular and pretesticular zones, but completely fill the posttesticular zone. The uterus is relatively short, consisting of a few loops confined to the intercecal field between the ovary and acetabulum; vagina about one-half the length of cirrus pouch, muscular, and without spines. Eggs 90μ to 97μ long by 45μ wide, oval in outline, but more or less triangular in cross section; shell yellow, thickened to form a knoblike projection at posterior pole; opercular pole flat.

Host.—*Phocaena phocoena* (=*Phocaena communis*).

Location.—Bile ducts.

Distribution.—Europe; North America (United States).

Remarks.—The above description is based upon specimens (U.S.N.M. Helm. Coll. No. 8415) collected by Dr. G. A. MacCallum, June 27, 1925, from the liver of *Phocaena phocoena* at Woods Hole, Mass. Two additional lots of specimens have also been examined. The first of these (U.S.N.M. Helm. Coll. No. 3379) was collected by Prof. Max Braun from the liver of *Phocaena communis* at Warnemünde, and identified as *Campula oblonga*. The date of collection is not given, but it is probable that this is a part of the material upon which his (1900) description of this species is based. The second lot of specimens (U.S.N.M. Helm. Coll. No. 16682) is labeled "*Campula oblonga*, liver, *Phocaena communis*, Millport, August 15, 1908, determined by Wm. Nicoll." In the case of this material, there appears to be no doubt that this represents a part of the specimens described by Nicoll in 1909. The specimens comprising both of these lots agree in all essentials with those from the MacCallum collection.

One of the outstanding characters which distinguish *C. oblonga* from all other species of the genus is the presence of anal openings. These structures are quite distinct and were found to occur in all specimens examined.

Anal openings have been reported as occurring in species belonging to the family Echinostomatidae by Leiper (1908) and by Odhner (1910c); in the Steringophoridae by Odhner (1911); in the Accacoeliidae by Looss (1912); in the Azygiidae and Allocreadiidae, and in *Schistorchis carneus* (syn. *Pleorchis oligorchis;* family uncertain) by Odhner (1928); in the Opecoelidae by Ozaki (1925; 1928); and in the Diploproctodaeidae by LaRue (1926) and by Ozaki (1928). Stunkard (1930) also demonstrated the presence of these openings in *Distomum* sp. of Linton, 1899, and proposed a new genus and species, *Bianium concavum*, for this trematode.

The genetic significance of the occurrence of anal openings in these worms is not clear. In two of the families, Opecoelidae and Diploproctodaeidae, these structures are present in all species in-

cluded in these groups; in other families, however, this does not hold true. So far as the family Fasciolidae is concerned, *C. oblonga* is the only species known to possess these structures; it appears, therefore, that anal openings in some species are characters of specific rather than generic or family significance.

CAMPULA PALLIATA (Looss, 1885) Looss, 1901

PLATE 2, FIGURES 6–7

Synonyms.—Distomum palliatum Looss, 1885, pp. 390–427; *Brachycladium palliatum* (Looss, 1885) Looss, 1899, p. 558; *Cladocoelium palliatum* (Looss, 1885) Stossich, 1892, pp. 10–11.

Description.—Campula: Body elongated, 9 mm to 10 mm long by 1.5 mm to 2 mm wide and 750μ to 1 mm thick; the anterior end is more rounded than the posterior end, and there is a definite constriction of the body in the vicinity of the acetabulum. Cuticle armed with closely set rows of pointed spines, 62μ to 76μ long by 5μ to 8μ wide, which completely cover the body. Suckers about equal in size and situated 2.5 mm to 3.5 mm apart. Pharynx ovoid, 380μ long by 293μ wide; esophagus 540μ wide. The intestinal tract consists of a pair of anteriorly directed ceca, one on each side, which extend to the level of the oral sucker, and a pair of posteriorly directed ceca, which extend to the posterior end of the body, both pairs of ceca being provided with short median and lateral diverticula. Excretory vesicle tubular, extending anteriorly dorsal of testes and dividing into two branches. Genital aperture median and situated a short distance cephalad of acetabulum. Cirrus pouch strongly muscular and situated mostly in front of acetabulum; it contains the seminal vesicle, ejaculatory duct, and cirrus. Testes lobed, tandem in position, situated in posterior part of middle third of body. Ovary irregular in outline, 489μ in greatest diameter, situated to left of median line and cephalad of anterior testis; seminal receptacle small; Laurer's canal present. Vitellaria abundantly developed and consisting of grapelike follicles, which extend from region of pharynx to posterior end of intestinal ceca. Uterus consists of numerous coils situated dorsal to acetabulum. Eggs 59μ long by 43μ wide, ellipsoidal, the opercular pole blunter than the posterior pole.

Host.—Delphinus delphis.

Location.—Liver (bile ducts).

Distribution.—Europe.

CAMPULA DELPHINI (Poirier, 1886) Bittner and Sprehn, 1928

PLATE 2, FIGURES 8–10

Synonyms.—Distomum delphini Poirier, 1886, pp. 34–36; *Cladocoelium delphini* (Poirier, 1886) Stossich, 1892, p. 10; *Brachycladium delphini* (Poirier, 1886) Looss, 1899, p. 558.

Description.—Campula: Body flat, 14 mm long by 2 mm wide, slightly attenuated at the extremities. Cuticle covered with small slender spines. Suckers about equal in size; acetabulum 700μ in diameter, oral sucker slightly smaller; distance between suckers 7 mm. Prepharynx short and wide; pharynx piriform in shape, 700μ long by 400μ wide; esophagus very short; intestine with short, anteriorly directed ceca, one on each side, which extend to the level of the oral sucker, and long posterior ceca, which extend to the posterior end of the body. The anterior ceca are provided with three more or less well-developed lateral diverticula, and the posterior ceca are provided with short diverticula throughout their course, especially along their lateral margins. Genital aperture median, situated a short distance cephalad of acetabulum; cirrus pouch short and wide, containing the seminal vesicle, short prostatic canal, and a poorly developed ejaculatory duct, and situated entirely in front of acetabulum. Testes large, ovoid, tandem in position, and situated in anterior part of the posterior third of body. Ovary small, spherical, situated cephalad of anterior testis and to the right of median line; Mehlis's gland well developed, to left of ovary; Laurer's canal present. Vitellaria well developed and occupying almost the entire surface of body, both dorsally and ventrally; they are composed of tubular glands entangled to form a compact network; the vitelline ducts unite cephalad of the genital aperture and caudad of posterior testis, and also between ovary and anterior testis where they form the vitelline reservoir. Uterus sinuous, situated between Mehlis's gland and genital aperture. Eggs elliptical, 60μ long by 45μ wide, slightly pointed posteriorly.

Host.—Delphinus delphis.

Location.—Liver (bile ducts).

Distribution.—Europe.

Remarks.—Odhner (1905) was of the opinion that this species was probably identical with *Brachycladium palliatum* Looss (=*Campula palliata*), since he stated: "Ich bin nämlich nicht völlig überzeugt, dass *Br. delphini* nicht mit dem demselben Wirte entstammenden *Br. palliatum* am Ende zusammenfallen könnte. Die Differenze in der Form der Hoden dürfte für das Auseinanderhalten der beiden Arten kaum genügen." Odhner's point regarding the form of the testes is well taken, but there are other characters which appear definitely to eliminate the likelihood of the two species being identical. In *Campula palliata* the uterus forms a rosette mass of coils dorsal to the acetabulum, the egg does not show a definite polar prolongation or thickening, and the anterior and posterior vitelline ducts do not anastomose. In *C. delphini* the uterus lies caudad of the acetabulum, the egg shows a marked polar thickening or prolongation, and the vitelline ducts anastomose anterior to the genital

aperture and posterior to the posterior testis. Despite the fact that Poirier's (1886) description of *C. delphini* is so somewhat incomplete, the writer feels that a restudy of specimens of this species will show it to be specifically distinct from *C. palliata* and perhaps to belong to a different genus. Aside from the shape of the ovary and testes, it appears to be more closely related to the genus *Lecithodesmus* than to the genus *Campula*, but the writer prefers to leave it in the latter genus until an examination of specimens of these forms is possible.

CAMPULA ROCHEBRUNI (Poirier, 1886) Bittner and Sprehn, 1928

PLATE 3, FIGURES 11–12

Synonyms.—Distomum rochebruni Poirier, 1886, pp. 36–37; *Cladocoelium rochebruni* (Poirier, 1886) Stossich, 1892, p. 11; *Brachycladium rochebruni* (Poirier, 1886) Looss, 1899, p. 558.

Description.—Campula: Body narrow, 10 mm long by 1 mm wide; ventral surface flat, dorsal surface slightly convex. Cuticle beset with very slender spines, which are especially abundant and close together on the anterior part of body. Suckers equal in size, 380μ in diameter (Poirier gives the diameter as 0.038 mm, but this undoubtedly is an error for 0.38 mm) and 700μ apart. Pharynx 490μ long by 180μ wide; esophagus very short; intestine as in *C. delphini*. Genital aperture immediately cephalad of acetabulum; cirrus pouch short and wide, preacetabular. Testes large, ovoid, tandem in position, and situated near equator of body. Ovary small, spherical, situated cephalad of anterior testis and to right of median line; Mehlis's gland more elongated and situated to left of ovary. Vitellaria composed of anastomosing tubular glands and extending over the greater part of body; the vitelline ducts do not anastomose in the anterior and posterior parts of body as in *C. delphini*. Uterus with few loops, situated between Mehlis's gland and genital sinus. Eggs oval, 82μ long by 45μ wide, strongly pointed posteriorly.

Host.—Delphinus delphis.

Location.—Liver.

Distribution.—Europe.

Genus LECITHODESMUS Braun, 1902

Generic diagnosis.—Campulinae: Body long, slender, and flattened dorsoventrally. Suckers widely separated. Intestinal ceca provided with median and lateral dendritic diverticula. Cirrus pouch extending slightly beyond posterior margin of acetabulum; cirrus unarmed; testes branched. Ovary deeply lobed; vitellaria in quadrangular groups of follicles extending from region of pharynx to posterior end of body. Parasites of cetaceans.

Type species.—Lecithodesmus goliath (van Beneden, 1858) Odhner, 1905.

LECITHODESMUS GOLIATH (van Beneden, 1858) Odhner, 1905

PLATE 3, FIGURES 15–16

Synonym.—*Distomum goliath* van Beneden, 1858, pp. 95–97.

Description.—*Lecithodesmus:* Body ribbonlike, 60 to 80 mm long by 8 mm wide and 1.6 to 1.8 mm thick (90 mm long by 9 mm wide, according to Lönnberg, 1891), anterior end bluntly rounded and posterior end slightly attenuated. Spines present on anterior part of body. [Odhner (1905) believes that the absence of spines on the posterior part is due to the effects of maceration for several days of habitual delay before specimens can be collected after the host has been killed.] Oral sucker 2.3 mm in diameter by 2 mm deep, subterminal in position; acetabulum 1.8 mm in diameter by 1.6 mm deep, according to Odhner (1.3 mm in diameter, according to Braun, 1902b), situated a little more than one-third of the body length from the anterior end (28 mm from oral sucker, according to Lönnberg). Prepharynx short; pharynx 1.5 mm long by 950μ wide (700μ wide, according to Braun); esophagus very short; intestinal ceca extend to posterior end of body and are provided with median and lateral dendritic diverticula. The anteriorly directed cecal appendages extend to the level of the middle of the pharynx, each being provided with four lateral diverticula. Excretory vesicle tubular and extending to level of ovary. Genital pore preacetabular; cirrus pouch club shaped, containing a large seminal vesicle and an unarmed cirrus 3 mm to 4 mm long. Testes branched, tandem in position, and situated in the posterior half of the body. Ovary star shaped, situated immediately cephalad of the anterior testis, slightly to right of median line. Laurer's canal present; seminal receptacle (?). The vitellaria consist of quadrangular groups of follicles extending both dorsally and ventrally from the level of the pharynx to the posterior end of body. According to Braun, the vitelline ducts consist of a long, slender, anterior duct, which bifurcates to form two lateral ducts that extend to a short distance caudad of ovary where they join the transverse ducts, and of a shorter, unpaired, posterior duct which bifurcates to form anterior lateral ducts which are sometimes connected by transverse anastomoses; the transverse ducts are formed by the union of the anterior and posterior lateral ducts. Uterus convoluted and terminating in a well-developed vagina, which opens into the genital sinus near the male genital aperture. Eggs 120μ long by 75μ wide, triangular in cross section.

Hosts.—*Balaenoptera acutorostrata* (=*B. rostrata*), *B. borealis*, and *Balaena mysticetus*.

Location.—Liver.

Distribution.—Europe.

Genus ZALOPHOTREMA Stunkard and Alvey, 1929

Generic diagnosis.—Campulinae: Body flattened, somewhat attenuated posteriorly and rounded anteriorly. Oral sucker terminal, larger than acetabulum. Intestinal ceca as in *Campula;* posterior ceca without anal openings. Excretory pore terminal; excretory vesicle tubular and extending to ovary. Cirrus pouch extending caudad of ovary; cirrus unarmed. Ovary indented but not lobed, pretesticular and slightly to right of median line; seminal receptacle absent; Laurer's canal present. Vitellaria as in *Campula.* Uterus coiled. Eggs with thickening at posterior pole, circular in cross section. Parasites of pinnipeds.

Type species.—*Zalophotrema hepaticum* Stunkard and Alvey, 1929.

ZALOPHOTREMA HEPATICUM Stunkard and Alvey, 1929

PLATE 3, FIGURES 13, 14

Description.—*Zalophotrema:* Body elongate and flattened dorsoventrally, 11 to 13 mm long by 3 to 3.6 mm wide, and from 600μ to 1 mm thick, the thickness decreasing abruptly immediately caudad of testes. Cuticle armed with spines, which vary from 14μ to 35μ in length. Oral sucker 700μ to 800μ long by 800μ to 1 mm wide; oral opening slightly subterminal. Acetabulum 570μ to 620μ in diameter, situated one-fifth to one-sixth of the body length from the anterior end. Pharynx piriform, 550μ to 600μ long by 380μ to 420μ wide. The digestive system bifurcates a short distance caudad of pharynx into two laterally directed branches, each of which bifurcates into a short anterior and a long posterior cecum; the anterior ceca terminate near the anterior end of pharnyx; the posterior ceca are provided with many median and lateral diverticula, and terminate near the posterior end of the body. Excretory pore terminal; excretory vesicle extending anteriorly as a simple sac to the region of the ootype. Cirrus pouch relatively weakly developed, extending from genital pore to level of ovary, according to Stunkard and Alvey (1930), and containing a coiled seminal vesicle, prostate cells, and an unarmed cirrus. Testes large and deeply lobed, tandem in position, and occupying the equatorial third of body. Ovary lobed, 500μ long by 1 mm wide, situated at caudal end of anterior third of body; Mehlis's gland posterior and dorsal to ovary; seminal receptacle absent; Laurer's canal present. The vitellaria consist of masses of follicles, which extend in the lateral areas of the body from the level of the pharynx to the posterior end; they tend to be dorsal in position in the anterior part of body, almost meeting in the median line cephalad of genital pore, while caudad of testes they are both dorsal and ventral in position and invade the median

field. The uterus consists of masses of coils filling the central part of body from the ovary to the acetabulum. The vagina is about one-half the length of the cirrus pouch. Eggs oval, 68μ to 79μ long by 43μ to 52μ wide, thickened at posterior pole and circular in cross section.

Host.—*Zalophus californianus.*

Location.—Bile ducts.

Distribution.—North America—United States (New York Aquarium and National Zoological Park, Washington, D. C.).

Remarks.—The foregoing description is slightly modified from that given by Stunkard and Alvey (1930).

Four specimens (U.S.N.M. Helm. Coll. No. 29731) of what appear to be this species were collected, March 17, 1930, from the liver of a specimen of *Zalophus californianus*, which died in the National Zoological Park, Washington, D. C. These specimens agree in all essential characters with the description given by Stunkard and Alvey except as regards the branching of the anterior ceca and in the length of the cirrus pouch. As regards the anterior ceca, Stunkard and Alvey state that "each of the anterior branches gives off two or three diverticula," but in the specimens at the writer's disposal no such diverticula were found. Two of the specimens showed a slight irregularity in the diameter of these ceca, but this appeared to be due to distention with ingesta. The cirrus pouch is described by Stunkard and Alvey as extending caudally to the level of the ovary, but in the writer's specimens this structure was found to extend to about midway between the posterior margin of the acetabulum and the anterior margin of the ovary. These differences, however, appear too slight to warrant considering the possibility of the writer's specimens representing a species distinct from *Z. hepaticum.*

Genus ORTHOSPLANCHNUS Odhner, 1905

Generic diagnosis.—Campulinae: Body elongated and slightly flattened; cuticle covered with pointed spines. Intestinal ceca without lateral or median diverticula. Genital pore preacetabular; cirrus pouch long and pestle shaped, extending beyond posterior margin of acetabulum; cirrus armed with strong pointed spines. Testes with indented margins, postequatorial and tandem in position. Ovary without lobes; seminal receptacle very small; Laurer's canal present. Vitellaria profusely developed, the follicles being distributed both dorsally and ventrally from region of pharynx to posterior end of body. Uterus with few coils; vagina well developed and lined with strong pointed spines. Eggs triangular in cross section. Parasites of pinnipeds.

Type species.—*Orthosplanchnus arcticus* Odhner, 1905.

KEY TO SPECIES OF ORTHOSPLANCHNUS

1. Body almost cylindrical; ventrally the vitelline follicles encroach on the testicular and uterine fields but do not extend anteriorly as far as pharynx .... fraterculus (p. 16).
   Body somewhat flattened; ventrally the vitelline follicles do not encroach on testicular and uterine fields but extend anteriorly beyond level of posterior end of pharynx .... arcticus (p. 15).

ORTHOSPLANCHNUS ARCTICUS Odhner, 1905

PLATE 4, FIGURES 17, 18

Description.—Orthosplanchnus: Body slightly flattened, 3.5 mm to 7 mm, usually 4.5 mm to 6 mm long by 850μ to 1.15 mm wide, tapering toward both ends, the posterior part of body being slightly more attenuated than the anterior part. Cuticle spiny throughout, the spines on the anterior part of body being about 40μ long, while those at both ends are somewhat smaller. Oral sucker 480μ to 600μ in diameter, subterminal in position; acetabulum 450μ to 530μ in diameter, situated about one-fourth of body length from anterior end. Prepharynx about 200μ long, pharynx about 400μ long by 300μ wide, esophagus 120μ to 150μ long. Intestine with short anteriorly directed ceca, one on each side, which extend to level of anterior end of pharynx, and long posterior ceca, which extend to end of body; both the anterior and posterior ceca are simple and without diverticula. Excretory pore terminal; excretory vesicle simple and tubular, and extending anteriorly to level of anterior margin of anterior testis. Genital aperture preacetabular, median; genital sinus spacious. Cirrus pouch pestle shaped and extending caudally to about midway between acetabulum and anterior testis (about two-fifths of the distance from acetabulum to ovary, according to Cooper, 1921); seminal vesicle more or less spherical and about 250μ in diameter when filled with sperms, more tubelike when empty; pars prostatica cylindrical, 170μ to 200μ long, and set off from the seminal vesicle by a sharp constriction; ejaculatory duct about the same length as pars prostatica; cirrus protrusible and spiny, the spines 40μ to 45μ long by 7μ wide at their bases and inserted into a basal disk 15μ to 19μ in diameter by 12μ thick. Testes elongated oval in shape, with indented margins; the anterior testis is usually slightly smaller than the posterior; they are tandem in position and situated in the anterior half of the posterior part of the body. Ovary entire, transversely oval in shape, situated cephalad of anterior testis and to the right of the median line; seminal receptacle very small; Laurer's canal present. Vitellaria profusely developed and extending both dorsally and ventrally of intestinal ceca from the level of the pharynx to the posterior end of the body; anterior to

acetabulum the follicles form a transverse dorsal band across body; ventrally the follicles do not encroach on the testicular and uterine fields; caudad of the testes the follicles coalesce in the median line and completely fill the posttesticular zone. The uterus extends anteriorly from Mehlis's gland in transverse loops to the acetabulum, where it terminates in a well-developed vagina, the cuticular lining of which is armed with spines similar to those of the cirrus. Eggs 91μ to 100μ long by 54μ to 58μ wide, triangular in cross section, and having a thickened posterior pole.

Hosts.—Erignathus barbatus (= *Phoca barbata*); *Phoca hispida.*

Location.—Gall bladder and liver.

Distribution.—Europe (west coasts of Greenland and Spitsbergen); North America (Canada—Bernard Harbor, Northwest Territories—according to Cooper, 1921).

ORTHOSPLANCHNUS FRATERCULUS Odhner, 1905

PLATE 4, FIGURE 19

Description.—Orthosplanchnus: Body almost cylindrical, 3 mm to 4 mm long by 500μ to 600μ wide. Cuticular spines more abundant than in *O. arcticus.* Oral sucker 370μ to 440μ in diameter; acetabulum 400μ to 500μ in diameter. Pharynx 300μ to 330μ long by 200μ wide; esophagus 220μ long. Cirrus pouch as in *O. arcticus.* Testes deeply indented. Vitellaria do not unite to form a dorsal band anterior to acetabulum, and ventrally they encroach on the testicular and uterine fields. Other characters as in *O. arcticus.*

Hosts.—Odobenus rosmarus; Erignathus barbatus.

Location.—Gall bladder.

Distribution.—Europe (Spitsbergen).

Genus SYNTHESIUM Stunkard and Alvey, 1930

Generic diagnosis.—Campulinae: Body long and slender. Suckers of equal size. Digestive system as in *Campula.* Cirrus pouch long and slender, inclosing seminal vesicle, pars prostatica, and spiny cirrus; testes deeply lobed as in *Lecithodesmus.* Ovary spherical, pretesticular; vitellaria consist of small, grapelike clusters of follicles and do not extend anteriorly as far as acetabulum; uterus with few coils; vagina lined with spines. Eggs with polar thickening. Parasitic in intestine of cetaceans.

Type species.—Synthesium tursionis (Marchi, 1873).

SYNTHESIUM TURSIONIS (Marchi, 1873), new combination

PLATE 5, FIGURES 20–21

Synonyms.—Distomum tursionis Marchi, 1873, p. 304; *Distomum longissimum* Poirier, 1886, pp. 29–30, not *D. longissimum* von Linstow,

1896; *D.* (*Dicrocoelium*) *tursionis* (Marchi, 1873) Parona, 1896, p. 162.

Description.—Synthesium: Body whitish, 20 mm long by 1.5 mm wide, flattened; cuticle spiny. Suckers equal in size, 800μ in diameter; acetabulum situated 3 mm to 4 mm caudad of oral sucker. Prepharynx 1 mm long; pharynx 720μ long by 300μ wide; intestinal ceca as in *Brachycladium* (=*Campula*), according to Odhner (1926). Genital aperture preacetabular; cirrus pouch long and tubular, and containing the seminal vesicle, a long slender pars prostatica, and cirrus (cirrus as in *Orthosplanchnus*, according to Odhner). Testes as in *Lecithodesmus*, according to Odhner; anterior testis with five lobes and posterior with six lobes, situated in posterior third of body, according to Poirier. Ovary small, almost spherical, pretesticular, and situated near the equator of body; Mehlis's gland a little larger than ovary. Vitellaria well developed and consisting of small grapelike clusters of follicles; they extend from a short distance cephalad of ovary to the posterior end of body. Uterus sinuous; vagina as in *Orthosplanchnus*. Eggs oval, 56μ long by 33μ wide, with thickening at posterior pole.

Host.—Delphinus tursio (probably=*Tursiops truncatus*).

Location.—Intestine.

Distribution.—Europe.

Remarks.—This description is taken largely from that given by Poirier (1886) for *Distomum longissimum.* The description given by Marchi (1873) for *D. tursionis* is very incomplete and the figure accompanying it is very sketchy. Parona (1896) restudied specimens from Marchi's original material and pointed out that *D. tursionis* Marchi and *D. longissimum* Poirier were identical, but added nothing to the original descriptions. Odhner (1926) reported that this species had the digestive tract of *Brachycladium* (=*Campula*), the lobed testes of *Lecithodesmus*, and the characteristic copulatory organs (charakterischen Endapparate der Geschlechtswege) of *Orthosplanchnus*, and suggested that it might be included in the latter genus. Recently Stunkard and Alvey (1930) proposed the genus *Synthesium* for this species. The writer is in accord with this action, since the inclusion of this species in the genus *Orthosplanchnus*, or in any of the related genera, would necessitate extensive revision of the diagnoses of these groups; this is regarded as inadvisable until more species have been described.

HADWENIUS, new genus

Generic diagnosis.—Campulinae: Body very long and slender, cylindrical, suckers close together; oral sucker slightly larger than acetabulum. Cuticle of anterior part of body spiny. Intestinal ceca without diverticula. Excretory vesicle tubular, extending anteriorly

to near posterior margin of ovary. Cirrus pouch pestle shaped, extending caudad of acetabulum; cirrus spiny as in *Orthosplanchnus*. Testes oval, tandem in position, situated in anterior fourth of body. Ovary transversely oval, pretesticular; seminal receptacle absent; Laurer's canal present. Vitellaria composed of rosette masses of radiating cords of follicles, which extend from vicinity of anterior testis to posterior end of body. Uterus with few coils confined to intercecal space between ovary and acetabulum; vagina well developed, unarmed. Eggs triangular in cross section, slightly thickened at posterior pole. Parasites of cetaceans.

Type species.—*Hadwenius seymouri*, new species.

HADWENIUS SEYMOURI, new species

PLATE 6, FIGURES 23–25

Description.—*Hadwenius:* Body slender, 27 mm to 60 mm long by 1.5 mm to 2 mm wide, and almost circular in cross section. The cuticle of the interior part of the body is spiny, the spines being about 27μ long by 7μ wide and arranged in alternating transverse rows; they are deep-set in the cuticle so that only the tips project above the surface. The rows of spines are close together in the region immediately caudad of the oral sucker, but become farther apart as they approach the region of the anterior testis, where they disappear completely. The oral sucker is cup shaped, 1.8 mm to 2 mm long by 1.7 mm to 2 mm in diameter, the thickness of the wall being about 190μ; the oral aperture is 540μ to 900μ in diameter and slightly subterminal. The acetabulum is transversely oval, 930μ to 1.2 mm long by 1.3 mm to 1.5 mm wide, and the walls are about 180μ thick; the distance between the suckers is from 800μ to 1.6 mm, depending upon the degree of contraction. The length of the prepharynx is variable; in some specimens it is about 810μ long, while in others the pharynx is drawn into the base of the oral sucker so that the prepharynx is very wide and short. The pharynx is 900μ to 1 mm long by 620μ to 900μ wide. The esophagus is very short and wide. The intestine is H shaped as in other members of the subfamily; the ceca are straight and without lateral or median diverticula. The excretory pore is situated at the summit of a papillalike prominence, which projects into a deep pit or depression at the posterior end of the body. The excretory vesicle is similar to that in other members of the subfamily. The genital aperture is situated immediately in front of the anterior margin of the acetabulum; it communicates with a spacious genital sinus. The cirrus pouch is pestle shaped, about 1.8 mm long by 560μ wide; it extends caudad a little more than half the distance between the acetabulum and

ovary. The seminal vesicle is about 830μ long by 290μ wide and almost fills the posterior part of the cirrus pouch; pars prostatica slender, about 700μ long, and separated from the seminal vesicle by a sharp constriction; ejaculatory duct relatively short. The cirrus is protrusible and armed with strong spines. The spines are about 40μ long and are inserted into a basal disk which is about 16μ in diameter. Testes oval in shape and situated in the anterior fourth of the body; the anterior testis is 900μ to 1.5 mm long by 620μ to 930μ wide, and the posterior 1 mm to 1.6 mm long by 620μ to 850μ wide, the distance between them being 310μ to 1.2 mm. The ovary is transversely oval, 232μ to 387μ long by 465μ to 590μ wide, situated a short distance cephalad of the anterior testis and to the right of the median line. Seminal receptacle not observed. Laurer's canal is slender and sinuous, and opens in the mid-dorsal line at the level of the ovary. Mehlis's gland is large and is situated median and dorsal to the ovary. The vitellaria consist of chainlike rows of follicles, which radiate to form rosettelike masses, and extend from the anterior testis to the posterior end of the body; the masses of follicles are distributed on all sides and form a continuous layer beneath the dermomuscular layer of the body. The uterus consists of six or more transverse coils confined to the intercecal field between Mehlis's gland and the acetabulum. The vagina is well developed, unarmed, and about one-half the length of the cirrus pouch; it opens at the base of the genital sinus to the left of the male genital aperture. The eggs are oval, 97μ long by 52μ wide, with a short prolongation at the posterior pole, triangular in cross section.

Host.—White whale (*Delphinapterus leucas*).

Location.—Intestine.

Distribution.—North America (Alaska).

Type specimens.—U.S.N.M. Helm. Coll. No. 30807; paratypes, No. 26157. Collected by Dr. Seymour Hadwen, September 9, 1921, at Golovin, Alaska.

Remarks.—*Hadwenius seymouri* appears to be more closely related to *Synthesium tursionis* than to any of the other species of Campulinae. Both are parasites of the intestinal tract of cetaceans and are similar in body form. They differ, however, in two principal characters, which are considered generic, viz, the copulatory organs and distribution of the vitellaria. In *Hadwenius seymouri* the cirrus is armed but the vagina is not, and the vitelline follicles are arranged in rosettelike masses similar to those in *Lecithodesmus*, while in *Synthesium tursionis* both cirrus and vagina are armed and the vitelline follicles are distributed in small grapelike groups. Other differences are present, but these appear to be only of specific value.

Genus ODHNERIELLA Skrjabin, 1915

Generic diagnosis.—Campulinae: Body flat and ribbonlike; cuticle of preacetabular part of body armed with spines. Oral sucker slightly smaller than acetabulum. Digestive tract without anteriorly directed ceca. Excretory vesicle as in *Campula.* Cirrus pouch saclike, extending beyond posterior margin of acetabulum; cirrus armed with spines as in *Orthosplanchnus;* testes entire. Ovary entire, pretesticular. Vitellaria consisting of grapelike masses of follicles, situated laterally and not invading median field, and extending from about midway between ovary and acetabulum to level of termination of ceca. Uterus relatively short; vagina unarmed. Eggs triangular in cross section. Parasites of pinnipeds.

Type species.—*Odhneriella rossica* Skrjabin, 1915.

ODHNERIELLA ROSSICA Skrjabin, 1915

PLATE 5, FIGURE 22

Description.—*Odhneriella:* Body flat and ribbonlike, 9 mm long by 760μ wide at acetabulum; sides of body almost parallel. Cuticle of preacetabular part of body armed with spines. Oral sucker directed ventrally, 500μ long by 480μ to 530μ wide; acetabulum 500μ long by 680μ wide, slightly elevated above surface of body, and situated in anterior part of body. Prepharynx 119μ long; pharynx 325μ long by 290μ wide; esophagus 230μ long; intestinal ceca simple and extending to posterior end of body; anteriorly directed ceca, characteristic of other members of the subfamily, absent. Excretory pore terminal; excretory vesicle as in other members of the subfamily. Genital pore median, near anterior margin of acetabulum. Cirrus pouch saclike, extending beyond posterior margin of acetabulum; cirrus strong and armed with spines. Testes oval, 935μ long by 390μ wide, entire, tandem in position, and situated in the posterior fourth of the anterior half of the body. Ovary globular, 300μ to 340μ in diameter, pretesticular. Vitellaria consisting of grapelike masses of follicles distributed along sides of body and extending from about midway between ovary and acetabulum to level of ends of ceca. Uterus short, with few coils, situated in the intercecal field between ovary and acetabulum; vagina straight and unarmed. Eggs oval, 100μ long by 60μ wide, thickened at posterior pole, triangular in cross section.

Host.—*Odobenus rosmarus.*

Location.—Bile ducts.

Distribution.—Europe (Russia).

Remarks.—The foregoing description, taken from Skrjabin (1915),[1] was based upon specimens collected by Doctor Starokadomsky, February 8, 1912, in north Russia, near Kaluchinskaya Bay.

Family ECHINOSTOMATIDAE Looss, 1902

Family diagnosis.—Body more or less elongate, small or very large, usually much flattened anteriorly, less so, or even cylindrical, posteriorly. Oral sucker small and weak, surrounded dorsally and laterally, but not ventrally, by a collarlike fold, bearing one or two rows of spines, which are continued laterally to ventral corners, the corner spines usually large or specialized; acetabulum large and powerful, usually preequatorial and near oral sucker. Cuticle usually spinose, especially anteriorly. Excretory vesicle Y shaped, with lateral twiglike branches. Pharynx and epithelial "pseudoesophagus" present; intestinal ceca extend to posterior end of body. Genital aperture preacetabular; genital sinus present or absent; cirrus pouch usually present. Testes postequatorial, usually tandem in position. Ovary pretesticular, usually to right of median line; Laurer's canal present. Vitellaria lateral, rarely extending anterior to acetabulum. Uterus in transverse coils, rarely extending beyond intercecal field. Parasites of intestines or bile ducts of vertebrates, especially birds.

Type genus.—*Echinostoma* Rudolphi, 1809.

Genus ECHINOSTOMA Rudolphi, 1809 (sensu lato)

Generic diagnosis.—Characters of the family.

ECHINOSTOMA ACANTHOIDES (Rudolphi, 1819) Cobbold, 1860

Synonym.—*Distoma acanthoides*, Rudolphi, 1819, p. 114.

Description.—*Echinostoma:* Body elongated and flattened (4 mm to 6 mm long, according to Dujardin, 1845), divided into a somewhat slender (271μ wide) anterior part and a broader (520μ wide) posterior part (Dujardin gives the maximum width of the body as 750μ) the two portions being united at the level of the acetabulum. Oral sucker 156μ long by 135μ wide; acetabulum 375μ long by 396μ wide, situated about one-third of the body length from the anterior end. Cephalic collar provided with four spines, 73μ long, on each ventral lobe, with 16 to 18 smaller spines, 59μ long, arranged around the margin in a single row, uninterrupted dorsally, and with one small spine,

[1] The writer is indebted to Dr. R. Ed. Schulz, of the School of Veterinary Medicine, Moscow, for a typewritten copy of Professor Skrjabin's paper, the publication in which this paper appeared being unavailable in this country.

26μ long, on each side between the larger spines of the ventral lobes and the smaller marginal spines. Pharynx 145μ long by 114μ wide, situated almost immediately caudad of the oral sucker. Testes globular 159μ in diameter, tandem in position and situated in the posterior part of the body. Vitellaria lateral, not extending anteriorly beyond acetabulum.

Host.—*Phoca vitulina.*

Location.—Intestine.

Distribution.—Europe (Berlin, Germany).

Remarks.—Rudolphi (1819) reported finding two specimens of this species in the above host in Berlin. Braun (1901a) redescribed this form on the basis of the original material and stated that the specimens were immature. The above description is compiled largely from that given by Braun.

It is not certain that this species belongs to the genus *Echinostoma*, *sensu stricto*. The arrangement of the spines of the cephalic collar tends to exclude it from the genus, but the other characters are not sufficiently well described to permit a definite generic assignment at present.

Genus STEPHANOPRORA Odhner, 1902

Synonyms.—*Mesorchis* Dietz, 1909a, p. 183; *Monilifer* Dietz, 1909a, p. 183.

Generic diagnosis.—Echinostomatidae: Body elongated and subcylindrical. Cuticle of anterior part of body armed with spines. Oral sucker surrounded by a well-developed reniform collar bearing a single row of spines, which is interrupted dorsally by a space about as wide as oral sucker. Acetabulum situated approximately one-fourth of body length from anterior end. Cirrus pouch well developed, containing seminal vesicle, pars prostatica, and a short, strong cirrus. Testes tandem in position, situated near equator of body. Ovary pretesticular. Vitellaria almost filling posttesticular part of body and extending anteriorly to anterior testis. Uterus moderately long and containing relatively few eggs.

Type species.—*Stephanoprora ornata* Odhner, 1902.

STEPHANOPRORA DENTICULATA (Rudolphi, 1802) Odhner, 1910

PLATE 7, FIGURES 29–30

Synonyms.—*Fasciola denticulata* Rudolphi, 1802, p. 91; *Distoma denticulatum* (Rudolphi, 1802) Rudolphi, 1809, p. 424–425; *Echinostoma denticulatum* (Rudolphi, 1802) Cobbold, 1860, p. 36; *Echinostoma (Mesorchis) denticulatum* (Rudolphi, 1802) Dietz, 1909a, p. 183; *Mesorchis denticulatus* (Rudolphi, 1802) Dietz, 1909b, p. 31.

Description.—Stephanoprora: Body elongated, 2.08 mm to 2.64 mm long by 288μ to 352μ wide at acetabulum. Cuticle of anterior part of body closely beset with spines arranged in alternating transverse rows; these rows are close together in the region anterior to acetabulum, but caudad of this point they are more widely separated and finally disappear in the region of the anterior testis. Oral sucker subterminal, 74μ to 92μ in diameter, surrounded by a well-defined reniform collar, 213μ to 237μ wide. The collar bears 22 spines arranged in a single row, which is interrupted dorsally by a space almost as wide as the oral sucker. Four of these spines, two on each ventral lobe, are slightly smaller and more aboral than the marginal spines; they measure 29μ to 37μ long by 11μ to 14μ wide; the marginal spines are 37μ to 44μ long by 11μ to 15μ wide. Acetabulum almost circular, 185μ to 222μ in diameter, situated 370μ to 560μ from anterior end of body. Prepharynx 37μ long; pharynx 81μ to 110μ long by 74μ wide; esophagus 92μ to 166μ long; intestinal ceca slender. Genital pore situated about midway between intestinal bifurcation and anterior margin of acetabulum. Cirrus pouch ovoid, 185μ to 222μ long by 48μ to 129μ wide, containing a large seminal vesicle, pars prostatica, and short cirrus. Testes tandem in position, situated in equatorial zone; anterior testis globular, 166μ to 229μ in diameter; posterior testis ovoid, 203μ to 259μ long by 148μ to 222μ wide. Ovary transversely oval, 85μ to 110μ long by 100μ to 122μ wide, situated cephalad of anterior testis and to right of median line. Vitellaria consisting of large follicles and extending from level of posterior margin of anterior testis to near posterior end of body. Uterus short and with few coils. Eggs 74μ to 77μ long by 52μ to 55μ wide.

Host.—Zalophus californianus.

Location.—Small intestine.

Distribution.—North America—United States (Washington, D. C.).

Specimens.—U.S.N.M. Helm. Coll. No. 28147. Collected by E. W. Price, June 1, 1928, from a California sea lion, which died in the National Zoological Park.

Family TROGLOTREMATIDAE Odhner, 1914

Family diagnosis.—Body compact, more or less flattened ventrally and convex dorsally. Cuticle with pointed spines. Body musculature as well as that of suckers weakly developed. Excretory vesicle Y shaped or tubular. Pharynx present; esophagus short; intestinal ceca extend to near posterior end of body. Genital pore near acetabulum, either immediately in front or behind, median or slightly to the left. Cirrus pouch absent except in *Troglotrema;* pars prosta-

tica and seminal vesicle always distinct. Testes opposite each other, equatorial or postequatorial. Ovary usually lobed, dextral, pretesticular; seminal receptacle and Laurer's canal present. Vitellaria usually well developed, exclusively or mostly dorsal, leaving only the median dorsal area of body unoccupied. Uterus either very long, with relatively few loops, or shorter and more convoluted. Parasites of carnivorous mammals and birds, usually occurring in pairs in cystlike cavities.

Type genus.—*Troglotrema* Odhner, 1914.

Genus PHOLETER Odhner, 1914

Generic diagnosis.—Troglotrematidae: Body more or less spindle shaped. Cuticle armed with small pointed spines, the spines not in groups. Excretory vesicle Y shaped, the bifurcation occurring in front of testes, and branches extending to acetabulum. Genital aperture at anterior border of acetabulum, slightly to left of median line; genital sinus moderately deep and wide; cirrus pouch absent; pars prostatica short, directed dorsoventrally; seminal vesicle tubelike, undivided, extending under the dorsal surface to near the ovary. Testes elliptical, situated opposite each other a short distance from the posterior end of body. Ovary deeply lobed; seminal receptacle present; Laurer's canal moderately long. Vitellaria strongly developed, dorsal in position, and having a tendency to occur in grapelike bunches. Uterus long and convoluted, occupying entire body width and extending from ovary to genital pore. Parasites of cetaceans.

Type species.—*Pholeter gastrophilus* (Kossack, 1910) Odhner, 1914.

PHOLETER GASTROPHILUS (Kossack, 1910) Odhner, 1914

PLATE 7, FIGURE 26

Synonym.—*Distomum gastrophilum* Kossack, 1910, pp. 118–120.

Description.—*Pholeter*: Body spindle shaped, 1.5 mm to 3.33 mm long by 1.7 mm to 2.1 mm wide according to Odhner (1914), or 3.15 mm to 3.66 mm long by 1.8 mm to 2.25 mm wide according to Kossack (1910), the thickness being about one-third of the width. Oral sucker 170μ to 200μ in diameter; acetabulum 250μ to 300μ in diameter, situated about one-third of the body length from the anterior end. Pharynx 150μ to 170μ in diameter; esophagus of same length as pharynx; intestinal ceca simple and terminating about the middle of testes. Genital pore situated at the anterior margin of acetabulum; cirrus pouch absent; pars prostatica short and directed

dorsoventrally; seminal vesicle tubelike; undivided. Testes elliptical, situated side by side in the posterior third of the body. Ovary deeply lobed, situated immediately cephalad of testes and slightly to one side of the median line; seminal receptacle moderately large, dorsal to ovary. Vitellaria dorsal and extending from about halfway between intestinal bifurcation and acetabulum to the level of the ends of the ceca. Uterus long and strongly looped, occupying almost the entire width of the body from the ovary to the genital pore; vagina short. Eggs oval, 23μ to 25μ long by 14μ wide.

Host.—*Phocaena phocoena* (=*P. communis*).

Location.—Stomach (encysted in the mucosa of the pylorus).

Distribution.—Europe.

Family OPISTHORCHIIDAE Braun, 1901

Family diagnosis.—Medium-sized to small forms; body elongate, flat, thin, transparent, with weak musculature. Suckers relatively weakly developed. Intestinal ceca simple, extending to posterior end of body. Excretory vesicle Y shaped with long stem and short branches. Genital aperture median, immediately preacetabular; no genital sinus containing suckerlike structures or gonotyls. Cirrus pouch and cirrus absent; seminal vesicle coiled. Testes in postequatorial region, situated more or less obliquely. Ovary pretesticular; seminal receptacle voluminous; Laurer's canal present. Vitellaria lateral of ceca, moderately developed, not reaching posterior end of body. Uterus long, with numerous loops, usually confined to intercecal space between ovary and acetabulum. Eggs small and numerous. Parasites of bile ducts and gall bladder of mammals, birds, fishes, and reptiles.

Type genus.—*Opisthorchis* R. Blanchard, 1895.

KEY TO SUBFAMILIES OF OPISTHORCHIIDAE

1. Vitellaria and uterus do not extend cephalad of acetabulum.
   Opisthorchiinae (p. 25).
   Vitellaria and uterus extend cephalad of acetabulum__ Metorchiinae (p. 30).

Subfamily OPISTHORCHIINAE Looss, 1899

Subfamily diagnosis.—Opisthorchiidae: Excretory pore terminal; stem of excretory vesicle long. Vitellaria do not extend anteriorly beyond level of acetabulum. Uterine coils usually confined to intercecal space and not extending anteriorly beyond acetabulum.

Type genus.—*Opisthorchis* R. Blanchard, 1895.

KEY TO GENERA OF OPISTHORCHIINAE OCCURRING IN MARINE MAMMALS

1. Uterine coils extend laterally beyond limits of intestinal ceca. **Cyclorchis** (p. 28).
   Uterine coils do not extend laterally beyond limits of intestinal ceca ---------- 2.
2. Vitellaria divided into two distinct regions by a break at the level of the ovary ---------- **Amphimerus** (p. 29).
   Vitellaria not divided into two regions ---------- **Opisthorchis** (p. 26).

Genus OPISTHORCHIS R. Blanchard, 1895

Generic diagnosis.—Opisthorchiinae: Body elongated, flattened, anterior end attenuated, posterior end broader. Cuticle generally smooth, without spines. Excretory vesicle Y shaped, with S-shaped stem and short branches. Cirrus pouch absent; testes usually lobed, situated in posterior part of body and placed obliquely to the long axis of the body. Ovary simple or lobate, pretesticular; seminal receptacle prominent, postovarial; Laurer's canal present. Uterus with numerous transverse loops confined to intercecal field, not extending anteriorly beyond acetabulum. Vitellaria moderately developed, extracecal, not extending anteriorly beyond level of acetabulum or posteriorly beyond level of ovary. Parasites of bile ducts of mammals, birds, and fishes.

Type species.—*Opisthorchis felineus* (Rivolta, 1884) R. Blanchard, 1895=*O. tenuicollis* (Rudolphi, 1819).

OPISTHORCHIS TENUICOLLIS (Rudolphi, 1819) Stiles and Hassall, 1896

PLATE 7, FIGURES 27, 28

Synonyms.—*Distoma tenuicollis* Rudolphi, 1819, p. 93; *D. conus* Gurlt, 1831, p. 193, not Creplin, 1870; *D. lanceolatum* von Siebold, 1836, p. 113, not Rudolphi, 1803; *D. felineum* Rivolta, 1884, pp. 20–28; *D. viverrini* Poirier, 1886, pp. 116–130; *Opisthorchis felineus* (Rivolta, 1884) R. Blanchard, 1895, p. 217; *O. viverrini* (Poirier, 1886) Stiles and Hassall, 1896, p. 155; *O. tenuicollis-felineus* Looss, 1899, p. 678.

Description.—*Opisthorchis:* Body flat, 6.5 mm to 8.5 mm long by 2.1 mm to 2.2 mm wide, anterior end somewhat more attenuated than posterior end. Cuticle smooth and without spines. Oral sucker subterminal, 320μ to 340μ in diameter; acetabulum 260μ to 320μ long by 300μ to 360μ wide, situated 1.4 mm to 1.6 mm from the anterior end of body. Pharynx ovoid to piriform in shape, 200μ long by 140μ to 160μ wide; esophagus 80μ to 140μ long; intestinal ceca slender and extending to near posterior end of body, the left cecum being slightly shorter than the right. Excretory vesicle Y shaped, with a long sigmoid stem and short branches. Genital aperture immediately cephalad of acetabulum. Seminal vesicle more or less

spirally coiled and free in parenchyma, situated posterior to acetabulum and to the right of the median line. Testes lobed and situated in the posterior third of body; the anterior testis has four lobes and measures 500μ to 600μ long by 660μ to 700μ wide; the posterior testis has five lobes and is 540μ to 700μ long by 680μ to 700μ wide. Ovary more or less trilobed, 160μ to 200μ long by 400μ to 440μ wide, situated slightly to right of median line and about 400μ to 440μ cephalad of anterior testis. Mehlis's gland diffuse, dorsad and cephalad of ovary; seminal receptacle large, somewhat ovoid or retort shaped, situated to the right and caudad of ovary; Laurer's canal long and slender. Vitellaria extracecal, each one composed of eight poorly defined groups of follicles which extend from a short distance caudad of acetabulum to level of ovary. Uterus with closely packed loops confined to intercecal field between ovary and acetabulum. Eggs oval, 27μ to 31μ long by 13μ to 15μ wide.

Hosts.—*Erignathus barbatus* (=*Phoca barbata*), *Halichoerus grypus*, *Phocaena phocoena* (=*Delphinus phocoena*=*Phocaena communis*), *Gulo borealis*, *Felis viverrina*, domestic cat, dog, and man.

Location.—Liver (bile ducts).

Distribution.—Europe; Asia (Siberia).

Remarks.—The above description is based upon specimens (U.S.N.M. Helm. Coll. No. 3357) labeled "*Opisthorchis felineus* (Riv.), *Halichoerus grypus*, Konigsberg Thiergarten, collected and determined by Mühling," which were donated to the helminthological collection by Prof. Max Lühe, June, 1902. These specimens are considerably smaller than the measurements given by various authors for *C. tenuicollis*, but so far as can be determined from the literature, this species exhibits considerable variation as regards size.

Whether *Opisthorchis tenuicollis* and *O. felineus* are identical species appears to be a moot question. Braun (1893) stated: "So reiht sich *Dist. tenuicolle* Rud. aus *Phoca barbata* dem *Dist. felineum* Riv. und verwandten Arten an." Mühling (1896, 1898a, and 1898b) was convinced of their morphological identity, as was Looss (1899). Barker (1911) noted that there was a lack of specific characters that would definitely separate the two species. Morgan (1927) also states that several species of the genus, including *O. tenuicollis* and *O. felineus*, are very similar and of questionable validity, and points out that widely different hosts, when feeding on the same intermediate host, may become infested with the same species of fluke. After studying the descriptions and figures of *O. tenuicollis* and *O. felineus*, the writer is convinced that they are the same morphological species and should no longer be regarded as distinct. There also appears to be no good reason for considering *O. viverrini* as valid, especially since the figure given by Fuhrmann (1928) shows that the uterine

coils are more closely packed than those figured by Poirier (1886) for this species, the distribution of the uterine coils being essentially the only character by which this species could be differentiated from *O. tenuicollis* (=*O. felineus*). It is also possible that *O. entzi*, described by von Ratz (1900) from the gall bladder of *Ardea purpurea*, and *O. geminus*, described by Looss (1896) from the liver of *Milvus parasiticus*, are species identical with *O. tenuicollis*, since the characters given fall within the range of variation exhibited in the latter species.

It appears that in the case of *O. tenuicollis* there is a lack of host specificity, as is also the case for *Cryptocotyle lingua* and certain other trematodes.

Genus CYCLORCHIS Lühe, 1908

Generic diagnosis.—Opisthorchiinae: Body more or less spindle shaped, the maximum width being near the equator. Cuticle without spines. Suckers about equal in size. Digestive tract and excretory vesicle as in *Opisthorchis*. Testes globular, situated in posterior fourth of body. Ovary and adjacent structures as in *Opisthorchis*. Vitellaria lateral, situated in posterior half of body, but not extending caudally beyond level of seminal receptacle. Uterine coils loosely arranged and extending laterally beyond limits of ceca.

Type species.—*Cyclorchis amphileucus* (Looss, 1896) Lühe, 1908.

CYCLORCHIS CAMPULA (Cobbold, 1876) Luhe, 1908

PLATE 8, FIGURE 31

Synonyms.—*Distoma campula* Cobbold, 1876, p. 40; *Metorchis campula* (Cobbold, 1876) Looss, 1899, p. 565; *Opisthorchis campula* (Cobbold, 1876) Looss, 1899, p. 559.

Description.—*Cyclorchis:* Body elliptical, about 3 mm long by 1 mm wide, slightly more attenuated anteriorly than posteriorly. Oral sucker subterminal; acetabulum about the same size as oral sucker, situated about one-fourth of the body length from the anterior end. Esophagus short; intestinal ceca relatively wide and sinuous, extending to posterior end of body. Genital pore preacetabular; testes ovoid and situated diagonally to the long axis in the posterior fourth of body. Ovary small; seminal receptacle large. The body which Cobbold says is "apparently the ovary" is probably the distended seminal receptacle, and the smaller body immediately in front of it is probably the ovary. Vitellaria (?). The uterus passes posteriorly and forms a transverse loop between the ovary and testes, and then passes anteriorly in transverse loops which extend laterally be-

yond the inner limits of the ceca. Eggs "1/1000 of an inch from pole to pole by 1/2100 inch in breadth."

Host.—*Platanista gangetica.*

Location.—Bile ducts.

Distribution.—Asia (India).

Remarks.—The foregoing description is taken largely from Cobbold's (1876) figure of *Distoma campula.* The description which he gives for this form is very incomplete, and almost no measurements are given. Cobbold confused this species with *Campula oblonga*, a species which he had described earlier from *Phocaena phocoena* (=*P. communis*), his identification being based largely on the zigzag course of the intestinal ceca. The species from *Platanista gangetica* is unquestionably an opisthorchid and has been placed in the genus *Cyclorchis* by Lühe (1908) as *species inquirenda.* The disposition of the reproductive organs, so far as they have been figured by Cobbold, is strikingly similar to that in *C. amphileucus* so that there appears to be good reason for including it in the same genus.

Genus AMPHIMERUS Barker, 1911

Generic diagnosis.—Opisthorchiinae: Body elongated and flattened, anterior end attenuated. Cuticle frequently covered wholly or in part with small spines. Excretory vesicle as in *Opisthorchis.* Cirrus pouch and cirrus absent; testes in posterior part of body, simple or lobate, situated diagonally to long axis of body. Ovary anterior to testes, simple or lobate; seminal receptacle well developed; Laurer's canal present. Vitellaria well developed, lateral of intestinal ceca, divided into two distinct regions by a break opposite the ovary, not extending anteriorly beyond the acetabulum, but frequently extending posteriorly to or beyond the posterior testis. Uterus anterior to ovary as in *Opisthorchis;* the coils may extend laterally beyond the inner limits of the ceca. Parasites of the bile ducts of mammals, birds, and reptiles.

Type species.—*Amphimerus ovalis* Barker, 1911.

AMPHIMERUS LANCEA (Diesing, 1850) Barker, 1911

PLATE 8, FIGURES 32–33

Synonyms.—*Distomum lancea* Diesing, 1850, p. 334; *Opisthorchis lancea* (Diesing, 1850) Braun, 1901c, p. 897.

Description.—*Amphimerus:* Body lanceolate, 5.5 mm to 12.5 mm long by 1 mm to 2.8 mm wide; anterior end conical and shorter than the flattened posterior portion; margins of posterior portion serrated. Oral sucker subterminal, 330μ to 360μ by 510μ to 660μ; acetabulum 510μ to 1.2 mm in diameter, situated one-third of the body length

from the anterior end. Genital pore preacetabular and median in position. Testes spherical or lobed, slightly oblique in position and situated in the posterior part of the body. Ovary biscuit shaped; seminal receptacle generally spindle shaped, situated caudad and to the right of the ovary; Mehlis's gland indistinct. Vitellaria lateral to intestinal ceca, consisting of eight groups of follicles on each side of body divided into two regions by a break between the fourth and fifth groups, and extending from a short distance caudad of the acetabulum to the ends of the intestinal ceca. Uterus consisting of transverse coils which extend intercecally from the ovary to the acetabulum. Eggs oval, 29μ to 33μ long by 12μ to 14μ wide.

Hosts.—*Delphinus tacuschi* (probably=*Sotalia tucuxi*), (?) *Orcaella brevirostris.*

Location.—Not given; probably bile ducts.

Distribution.—South America (Brazil—Barra do Rio Negro), (?) Asia (India).

Cobbold (1876) reported what he thought was this species from *Orcaella brevirostris,* the specimens upon which the report was based having been collected in "the North-eastern Province of India" by Dr. John Anderson, superintendent of the Indian Museum, Calcutta. The character which apparently caused Cobbold to regard the form from India as the same as that from Brazil was the "irregularly serrated" margin of the body, since he states: "I know of no other trematode possessing these sinuosities." The description and figure which he gave are quite different than those given by Diesing (1855) and by Weski (1900). The writer doubts whether the form which Cobbold calls *Distoma lancea* is the same as Diesing's species, but on account of the incompleteness of his description and figure, no opinion is expressed as to its probable affinities.

Subfamily METORCHIINAE Lühe, 1909

Subfamily diagnosis.—Opisthorchiidae: Excretory pore ventral; stem of excretory vesicle usually short, ventral to testes. Vitellaria extend cephalad of acetabulum. Uterine coils frequently overlap ceca and extend cephalad of acetabulum.

Type genus.—*Metorchis* Looss, 1899.

KEY TO GENERA OF METORCHIINAE OCCURRING IN MARINE MAMMALS

1. Posterior end truncate and suckerlike........ Pseudamphistomum (p 31)
   Posterior end rounded.................................. Metorchis (p. 30).

Genus METORCHIS Looss, 1899

Generic diagnosis.—Metorchiinae: Body rounded posteriorly and attenuated anteriorly. Cuticle usually covered with spines. Intestinal ceca extend to posterior end of body. Testes large, usually

lobed, and more or less obliquely placed, and almost filling posterior part of body. Ovary, Mehlis's gland, seminal receptacle, and Laurer's canal as in *Opisthorchis*. Vitellaria compact and extending anteriorly beyond acetabulum. Uterine coils often extend extracecally and preacetabular. Parasitic in gall bladder and bile ducts of mammals and birds.

Type species.—*Metorchis albidus* (Braun, 1893) Looss, 1889.

METORCHIS ALBIDUS (Braun, 1893) Looss, 1899

PLATE 8, FIGURE 34

Synonyms.—*Distomum albidum* Braun, 1893, pp. 347–355; *D.* (*Dicrocoelium*) *albidum* Braun, 1893, p. 353; *Opisthorchis albidus* (Braun, 1893) Railliet, 1896, p. 160.

Description.—*Metorchis*: Body spatulate, 1.6 mm to 2.2 mm long by 800μ to 1 mm wide; anterior part of body narrower than the flat posterior part. Cuticle covered with small spines. Oral sucker subterminal, 200μ to 240μ in diameter; acetabulum 200μ in diameter and situated 600μ to 900μ from the anterior end of the body. Pharynx ovoid, 75μ to 90μ long by 47μ to 85μ wide; esophagus 28μ long; intestinal ceca extend to posterior end of body. Genital aperture preacetabular; seminal vesicle relatively short. Testes lobed, oblique in position, the left testis anterior to right, and situated in the posterior part of the body; the anterior testis is 300μ to 340μ long by 300μ to 380μ wide, and the posterior 320μ long by 380μ wide. Ovary somewhat triangular in shape, 100μ to 180μ long by 140μ to 180μ wide, situated a short distance in front of anterior testis. Seminal vesicle large and situated posterolateral of ovary; Mehlis's gland diffuse. Vitellaria lateral and extending from near level of intestinal bifurcation to level of ovary. Uterus greatly convoluted and occupying the greater part of the intervitellarian field from the ovary to a short distance cephalad of acetabulum. Eggs 27μ to 32μ long by 13μ to 16μ wide.

Hosts.—*Halichoerus grypus*, *Felis domestica*, *Vulpes vulpes*, and *Canis familiaris*.

Location.—Gall bladder and bile ducts.

Distribution.—Europe.

Genus PSEUDAMPHISTOMUM Lühe, 1908

Generic diagnosis.—Metorchiinae: Body conical in shape, anterior end pointed; posterior end truncate and surrounded by a ridge giving it a suckerlike appearance. Cuticle beset with fine spines. Excretory pore in center of posterior suckerlike structure. Intestinal ceca slightly sinuous, extending to posterior end of body. Genital

pore preacetabular; cirrus pouch and cirrus absent; seminal vesicle convoluted, free in parenchyma. Testes in posterior third of body, placed slightly obliquely to long axis of body. Ovary median in position, situated about midway between anterior border of testes and acetabulum; seminal receptacle voluminous, postovarial. Vitellaria extracecal and consisting of relatively large groups of follicles extending from level of seminal receptacle to level of genital pore or slightly beyond. Uterus greatly convoluted, extending laterally over ceca and anteriorly beyond acetabulum. Parasites of bile ducts of mammals.

Type species.—*Pseudamphistomum truncatum* (Rudolphi, 1819) Lühe, 1908.

PSEUDAMPHISTOMUM TRUNCATUM (Rudolphi, 1819) Lühe, 1908

PLATE 8, FIGURE 35

Synonyms.—*Amphistoma truncatum* Rudolphi, 1819, p. 91; *Distoma conus* Creplin, 1825, pp. 50–53; *Distomum lanceolatum* Mehlis of Diesing, 1858, p. 332; *Distoma campanulatum* Ercolani, 1875, pp. 432–439; *Metorchis truncatus* (Rudolphi, 1819) Looss, 1899, p. 565.

Description.—*Pseudamphistomum:* Body conical, 2 mm long, anterior end pointed, posterior end truncate and suckerlike. Cuticle thickly and regularly beset with fine spines. Oral sucker 132μ to 137μ in diameter; acetabulum about same size as oral sucker and situated slightly preequatorial. Excretory pore situated in the depression of the posterior suckerlike structure. Pharynx 91μ long; esophagus very short; intestinal ceca slightly sinuous and extending to posterior end of body. Genital aperture preacetabular; seminal vesicle convoluted and free in parenchyma. Testes globular or slightly elliptical, 172μ to 376μ long, situated in the posterior third of the body, one slightly in front of the other. Ovary globular, situated about midway between the anterior border of the anterior testis and the acetabulum, usually obscured by the uterine coils; seminal receptacle voluminous, postovarial. Vitellaria situated laterally, chiefly in the middle third of body, each composed of 10 to 12 groups of follicles. Uterus greatly convoluted, occupying the greater part of the body width between testes and acetabulum, and extending somewhat in front of acetabulum. Eggs 29μ long by 11μ wide.

Hosts.—*Phoca vitulina*, *P. groenlandica*, *P. hispida*=*Halichoerus foetidus*, *Halichoerus grypus*, *Gulo borealis*, *Felis domestica*, *Canis familiaris*, *C. vulpes*.

Location.—Bile ducts.

Distribution.—Europe (Germany, Holland, Italy, France).

Family HETEROPHYIDAE Odhner, 1914

Family diagnosis.—Small or very small forms, usually not exceeding 2 mm in length. Anterior portion of body thinner, usually more slender and more movable than the posterior portion. Surface of body covered with small scalelike spines that become reduced posteriorly and may disappear toward the posterior end of the body. Intestinal ceca simple, usually extending to the posterior end of the body. Genital pore in the immediate neighborhood of the acetabulum; genital ducts usually open into a genital sinus, which may be variously modified and contain a cirruslike body or gonotyl (genital sucker). Acetabulum usually median in position, but may be displaced to the right of the median line; in some instances the acetabulum may be partially or completely atrophied and inclosed in the genital sinus. Cirrus pouch absent. Seminal vesicle well developed, U or S shaped, the vas deferens surrounded proximally by a mass of prostatic cells. Testes oval, globular, or slightly lobed, near the posterior end of the body, side by side, or obliquely one in front of the other. Ovary oval, globular or slightly lobed, pretesticular, usually to the right of the median line. Seminal receptacle and Laurer's canal present near the ovary, usually in relation with its posterior border. Vitellaria, located mainly in the lateral fields, may extend anteriorly to or beyond the genital aperture. Uterus usually restricted to the intercecal field between the ovary and genital pore, but may extend to posterior end of body (*Galactosomum*). Adults parasitic in the intestine of birds and mammals.

Type genus.—*Heterophyes* Cobbold, 1866.

KEY TO THE GENERA OF HETEROPHYIDAE OCCURRING IN MARINE MAMMALS

1. Acetabulum absent; uterus extending to posterior end of body. Galactosomum (p. 39).
   Acetabulum present; uterus not extending caudally beyond anterior border of testes ---- 2.
2. Acetabulum not contained in the genital sinus; seminal receptacle median and slightly preovarial; vitellaria not extending to acetabulum ---- Phocitrema (p. 38).
   Acetabulum contained in the genital sinus; seminal receptacle lateral and postovarial; vitellaria extending cephalad of acetabulum ---- 3.
3. Genital sinus large; genital ducts open into sinus caudad of acetabulum ---- Cryptocoyle (p. 33).
   Genital sinus small; genital ducts open into sinus cephalad of acetabulum ---- Apophallus (p. 35).

Genus CRYPTOCOTYLE Lühe, 1899

Synonyms.—*Tocotrema* Looss, 1899, p. 585; *Hallum* Wigdor, 1918, p. 254; *Ciureana* Skrjabin, 1923, p. 67.

Generic diagnosis.—Heterophyidae: Body ovoid to linguiform in shape. Prepharynx very short; esophagus short; intestinal bifurcation nearer to oral sucker than to acetabulum; intestinal ceca extend into posterior end of body and terminate caudad of testes. Acetabulum rudimentary, in anterior wall of the spacious, more or less muscular, genital sinus; genital ducts open into sinus at base of a single papillalike gonotyl; genital aperture postacetabular, in center of genital sinus. Seminal vesicle well developed, curved in a more or less S-like manner, dorsal to uterine coils. Testes near posterior end of body, irregularly oval or slightly lobed, either side by side or the right testis obliquely behind left. Ovary irregularly oval or lobed, situated to right of median line and cephalad of seminal receptacle. Vitellaria fill posttesticular space and extend anteriorly to acetabulum or beyond. Uterus with few loops, confined to intercecal space between ovary and genital sinus.

Type species.—*Cryptocotyle concava* (Creplin, 1825) Fischoeder, 1903.

CRYPTOCOTYLE LINGUA (Creplin, 1825) Fischoeder, 1903

PLATE 9, FIGURE 36

Synonyms.—*Distoma lingua* Creplin, 1825, pp. 27–38; *Tocotrema lingua* (Creplin, 1825) Looss, 1899, p. 586; *Distomum macrorhinis* MacCallum, 1916, p. 34; *Hallum caninum* Wigdor, 1918, pp. 254–257.

Description.—*Cryptocotyle:* Body linguiform, 550μ to 2 mm long by 200μ to 900μ wide. Cuticle covered with scalelike spines, 2μ to 4μ long by about 1μ wide. Oral sucker 66μ to 110μ in diameter; prepharynx shorter than pharynx; pharynx 40μ to 80μ long by 30μ to 48μ wide. Esophagus short, about 40μ to 60μ long. Genital sinus 120μ to 250μ in diameter, situated near equator of body; acetabulum rudimentary, in anterior wall of sinus. Seminal vesicle long and coiled in an S-like manner, extending caudally to about the level of the anterior border of ovary. Testes irregularly globular or ovoid in shape, 120μ to 250μ by 70μ to 130μ, margins uneven or slightly lobed. Ovary lobed, 70μ to 120μ long by 140μ to 180μ wide, situated to right of median line; seminal receptacle ovoid in shape and situated caudad of ovary. Vitellaria extend anteriorly beyond acetabulum and caudally to posterior end of body. Uterus confined to intercecal space between ovary and genital sinus. Eggs oval, 49μ to 50μ long by 18μ to 25μ wide.

Hosts.—Birds (*Colymbus auritus*, *Gavia immer*, *Larus marinus*, *L. argentatus*, *L. fuscus*, *L. atricilla*, *Nycticorax nycticorax*, *Rissa tridactyla*, *Alca torda*, *Sterna dougalli*, *S. hirundo*) and mammals

(*Canis familiaris*, *Vulpes fulva*, *Phoca vitulina*, and *Mirounga angustirostris*).

Location.—Small intestine.

Distribution.—Europe and North America (United States, Canada).

Remarks.—*Cryptocotyle lingua* appears to have been reported but twice from pinnipeds. Ransom (1920) reported this species from *Phoca vitulina*, the report being based upon specimens (U.S.N.M. Helm. Coll. No. 4280) collected by Dr. Albert Hassall, December 21, 1905, at Washington, D. C. MacCallum (1916) described a trematode, *Distomum macrorhinis*, from specimens collected from an elephant seal, *Macrorhinus angustirostris* (=*Mirounga angustirostris*), which died at the New York Aquarium. The writer has examined the specimens upon which MacCallum based his description of *D. macrorhinis* and finds no differences which would warrant regarding this form as a species distinct from *Cryptocolyle lingua*.

Genus APOPHALLUS Lühe, 1909

Synonyms.—*Rossicotrema* Skrjabin and Lindtrop, 1919, p. 40; *Cotylophallus* Ransom, 1920, p. 529.

Generic diagnosis.—Heterophyidae: Body ovoid to very elongated in shape. Prepharynx short; esophagus long; intestinal bifurcation usually nearer to acetabulum than to oral sucker; intestinal ceca slender, terminating as in *Cryptocotyle*. Acetabulum relatively well developed, opening into a small, nonmuscular genital sinus; genital ducts open into sinus at the base of two papilliform gonotyls; genital aperture cephalad of acetabulum. Seminal vesicle well developed, C or S shaped, dorsal to uterine coils. Testes ovoid or globular, situated near posterior end of body, the right usually behind left. Ovary ovoid or globular, situated to right of median line cephalad of seminal receptacle. Vitellaria fill posttesticular space and extend usually to acetabulum or beyond. Uterus as in *Cryptocotyle*.

Type species.—*Apophallus mühlingi* (Jägerskiöld, 1899) Lühe, 1909.

KEY TO SPECIES OF THE GENUS APOPHALLUS OCCURRING IN MARINE MAMMALS

1. Esophagus longer than prepharynx; seminal vesicle slender, S shaped; vitelline follicles relatively small, not extending anteriorly as far as pharynx ---------- donicus (p. 36).
   Esophagus shorter than prepharynx; seminal vesicle wide, C shaped; vitelline follicles relatively large, extending to level of pharynx ---------- zalophi (p. 36).

APOPHALLUS DONICUS (Skrjabin and Lindtrop, 1919) Price, 1931

PLATE 9, FIGURE 37

Synonyms.—*Rossicotrema donicum* Skrjabin and Lindtrop, 1919, pp. 41–42; *R. simile* (Ransom, 1920) Ciurea, 1924, p. 14; *Cotylophallus venustus* Ransom, 1920, p. 555; *C. similis* Ransom, 1920, p. 555.

Description.—*Apophallus*: Body ovoid to linguiform in shape, 500μ to 1.14 mm long by 200μ to 390μ wide. Cuticular scalelike spines 4μ to 7.5μ long by 1.5μ to 3μ wide. Oral sucker 65μ to 85μ in diameter; prepharynx very short; pharynx 30μ to 44μ in diameter; esophagus slender, bifurcating 135μ to 265μ from the anterior end of body; intestinal ceca simple, extending into posterior fourth of body. Acetabulum 45μ to 58μ long by 48μ to 60μ wide, situated 185μ to 560μ from the anterior end of body. Testes oval or globular in shape, 80μ to 200μ by 60μ to 200μ, situated obliquely in extended specimens, more or less opposed in more contracted specimens, and occupying the posterior third of the body. Ovary 65μ to 140μ by 40μ to 120μ, situated 200μ to 750μ from the anterior end of body. Seminal receptacle 60μ to 130μ wide by 35μ to 90μ long, situated between the posteromedian border of the ovary and the anteromedian border of the left testis. Vitellaria well developed, extending from posterior end of body to slightly beyond the bifurcation of the ceca. Uterus with few coils and occupying the intercecal space between anterior border of the left testis and the anterior margin of acetabulum. Eggs 30μ to 35μ long by 16μ to 20μ wide.

Hosts.—*Canis familiaris*, *Felis domestica*, *Vulpes lagopus*, and *Phoca vitulina*.

Location.—Small intestine.

Distribution.—Europe and North America (United States).

Remarks.—This description is taken from that of Ransom (1920) for *Cotylophallus similis*, the specimens (U.S.N.M. Helm. Coll. No. 4279) upon which the description was based having been collected from the harbor seal by Dr. Albert Hassall, in Washington, D. C., December 21, 1905. The writer has compared these specimens with specimens from dogs and cats and agrees with Witenberg (1929) that there is no reason for regarding this form as a species distinct from *A. donicus* (= *R. donicum*).

APOPHALLUS ZALOPHI, new species

PLATE 9, FIGURE 38

Description.—*Apophallus:* Body elongated piriform in shape, 435μ long by 215μ to 263μ wide at the level of the ovary. The cuticle is beset with small scalelike spines, 4μ long by 2μ wide, arranged in al-

ternating tranverse rows. Oral sucker slightly subterminal in position, 60μ to 75μ in diameter. Prepharynx 30μ to 33μ long; pharynx ovoid to spherical in shape, 29μ to 33μ wide; esophagus 18μ long; intestinal ceca relatively wide and extending to near the posterior end of the body, their blind ends being hidden by the testes. The acetabulum is circular, 52μ to 60μ in diameter, situated from 235μ to 259μ from the anterior end of the body and inclosed in the shallow genital sinus. The genital ducts open into the anterior part of the sinus and two elliptical gonotyls are present, one on each side of the genital aperture. The seminal vesicle is voluminous, more or less **C** shaped, and lying to the right of the acetabulum; there is a sharp constriction of the vesicle near the level of the posterior margin of the acetabulum which divides it into an anterior piriform part and a posterior globular part. The testes are somewhat triangular in outline, 81μ to 96μ by 81μ to 110μ, and are situated side by side in the posterior fourth of the body. The ovary is more or less triangular in outline, 55μ to 75μ by 67μ to 92μ, situated a short distance cephalad of the right testis. The seminal receptacle is spherical, 44μ in diameter, and situated dorsal to the ovary and right testis. The vitellaria consist of large, closely packed follicles, which extend from the level of the acetabulum to the level of the anterior margin of the testes; the follicles are distributed over the entire dorsal surface but ventrally they are chiefly lateral except near the intestinal bifurcation where they form a distinct band across the body. The uterus consists of a few loops confined to the intercecal field between the anterior margin of the testes and the genital aperture. The eggs are 33μ long by 18μ wide, golden yellow, and slightly piriform in shape.

Host.—Zalophus californianus.

Location.—Small intestine.

Distribution.—North America (United States—National Zoological Park, Washington, D. C.).

Type specimens.—U.S.N.M. Helm. Coll. No. 30808; paratypes, No. 26652.

Remarks.—Apophallus zalophi is easily distinguished from *A. donicus*, the only species of the genus with which it might possibly be confused, by its size, relative length of the prepharynx and esophagus, and by the distribution of the vitellaria. *A. zalophi* is on the whole a much smaller species than *A. donicus* and the body is somewhat thicker. The prepharynx is longer than the esophagus in *A. zalophi*, while in *A. donicus* the reverse is true. The vitelline follicles are relatively larger in *A. zalophi* and extend from the level of the pharynx to the anterior margin of the testes, while in *A. donicus* the follicles extend from about midway between the pharynx and intestinal bifurcation to the posterior end of the body. The arrangement of the genital glands is essentially the same in

both species; there is, however, a greater tendency for the testes to be opposed in *A. zalophi* than in *A. donicus*.

Genus PHOCITREMA Goto and Ozaki, 1930

Generic diagnosis.—Heterophyidae: Body fusiform in shape, cuticle spiny. Oral sucker terminal; acetabulum not inclosed in a genital sinus. Prepharynx shorter than esophagus; intestinal ceca simple and terminating at the anterior border of testes. Genital pore median, immediately preacetabular; testes almost directly opposite each other in posterior part of body; seminal vesicle slender, C shaped, lying free in parenchyma. Ovary oval, pretesticular, situated to right of median line; seminal receptacle large and situated anteromedian of ovary; vitellaria lateral, in posterior half of body; uterus with few transverse coils extending intercecally and extracecally between testes and genital pore.

Type species.—*Phocitrema fusiforme* Goto and Ozaki, 1930.

Remarks.—Goto and Ozaki (1930) place this genus in the family Opisthorchiidae. It appears to the writer, however, that its affinities are with the Heterophyidae rather than with the Opisthorchiidae, and it is included in this family in spite of the apparent absence of some characters which would definitely determine its systematic position.

PHOCITREMA FUSIFORME Goto and Ozaki, 1930

PLATE 9, FIGURE 40

Description.—*Phocitrema:* Body fusiform in shape, 1.16 mm to 1.4 mm long by 500μ to 620μ wide. Cuticle covered with minute spines. Oral sucker terminal, 80μ long by 60μ wide; acetabulum 120μ in diameter, slightly preequatorial in position. Prepharynx 80μ long by 60μ wide; esophagus 120μ to 180μ long, bifurcating about midway between pharynx and acetabulum; intestinal ceca terminate at the level of the anterior border of the testes. Genital pore median and situated immediately cephalad of the acetabulum; seminal vesicle elongate, cylindrical, forming a transverse loop between ovary and acetabulum; vas deferens slender, surrounded by glandular cells, expanding at anterior margin of acetabulum to form a bulbous pars prostatica which is surrounded by conspicuous gland cells. Testes oval or reniform in shape, 160μ to 240μ by 120μ to 140μ, situated opposite each other in the anterior part of the posterior fourth of body. Ovary ovoid, about the size of one of the testes, situated to the right of the median line in front of the right testis. Seminal receptacle large, situated obliquely anterior to ovary. Vitellaria consist of five to seven groups of small follicles on each side of the

posterior half of body. The uterus begins with irregular transverse coils on the left side of ovary, then passes to the right around the ovary and forms two transverse loops caudad of the acetabulum, the loops extending into the extracecal fields; vagina nearly straight, 140μ long, opening close to the male aperture. Eggs 23 to 28μ long by 13 to 15μ wide.

Host.—*Phoca hispida.*

Location.—Intestine.

Distribution.—Asia (Japan—Hanayashiki Zoological Garden, Tokyo).

Genus GALACTOSOMUM Looss, 1899

Synonyms.—*Microlistrum* Braun, 1901b, p. 563; *Cercarioides* Witenberg, 1929, p. 138.

Generic diagnosis.—Heterophyidae: Body elongated and spindle-like in outline, or expanded anteriorly and more or less cylindrical posteriorly. Prepharynx usually distinct, longer than esophagus; intestinal ceca simple, extending to posterior end of body. Genital aperture situated medially, about one-third of the body length from the anterior end. Genital sinus complicated, containing a spiny, spheroidal, more or less muscular body (gonotyl ?) imbedded in the dorsal wall of the sinus. Seminal vesicle well developed, free in parenchyma, the terminal portion of the vesicle being provided with a muscular wall (expulsor). Testes ovoid, spherical or slightly lobed, tandem or slightly oblique in position, and situated in the posterior half of the body. Ovary spherical or ovoid in shape, situated slightly to the right of the median line and cephalad of the seminal receptacle. Vitellaria extracecal or expanding medially in the posttesticular space, and extending anteriorly as far as the anterior testis or beyond. Uterus with a descending and an ascending limb, both passing between testes.

Type species.—*Galactosomum lacteum* (Jägerskiöld, 1896) Looss, 1902.

Remarks.—The genus *Galactosomum* was proposed by Looss (1899) to contain *Monostomum lacteum* Jägerskiöld. Braun (1901b) proposed the genus *Microlistrum* to contain three species, *Distomum cochleariforme* Rudolphi, 1819, *D. cochlear* Diesing, 1850, and *M. spinetum* Braun, 1901b. Odhner (1910a) pointed out that the structure which Braun interpreted as an acetabulum in the species included in the genus *Microlistrum* was the same structure as that described by Jägerskiöld (1896) as the "stacheligen Körper" in *Galactosomum lacteum.* Other similarities were also noted between the two genera. Pratt (1911) gave a redescription of *M. cochleariforme* and showed that the character of the genitalia was essentially

the same as that described by Jägerskiöld for *Monostomum lacteum;* on the basis of this similarity he transferred *M. cochleariforme* to the genus *Galactosomum*, making the two genera synonymous. Travassos (1929) apparently recognizes this arrangement, but Witenberg (1929) regards the two genera as distinct "because of differences in the arrangement of the genital glands." The writer (Price, 1931) has shown that the arrangement of the genital glands is subject to considerable variation within a genus and is a character of no generic importance in the Heterophyidae.

In the same paper, Witenberg proposed a new genus, *Cercarioides*, as the basis for a new subfamily, Cercarioidinae, the type species, *C. aharonii*, being characterized by having a dilated anterior part of the body set off by a slight constriction from the more cylindrical posterior part. To this new genus, Nazmi (1930) added an additional species, *C. baylisi*. A comparison of the descriptions shows no essential differences between these species and those belonging to the genus *Galactosomum*. The anterior widening of the body in *C. aharonii* and in *C. baylisi* is only slightly more pronounced than that in *G. cochleariforme;* the arrangement of the genital glands, the course of the uterus, and the terminal portions of the genital ducts also appear to be similar. Therefore, the writer regards *Cercarioides* Witenberg as a synonym of *Galactosomum* Looss, the two species *C. aharonii* Witenberg and *C. baylisi* Nazmi becoming *G. aharonii* (Witenberg) and *G. baylisi* (Nazmi), respectively.

GALACTOSOMUM ERINACEUM (Poirier, 1886) Bittner and Sprehn, 1928

PLATE 9, FIGURE 39

Synonyms.—Distomum erinaceum Poirier, 1886, pp. 37–38; *Astiotrema erinacea* (Poirier, 1886) Stossich, 1904, p. 2.

Description.—Galactosomum: Body elongated, 3 mm long by 800μ wide, the anterior half of the body being wider than the posterior half. Cuticle beset with spines, which become less numerous toward the posterior end of body. Oral sucker 300μ in diameter. Excretory vesicle tubelike, curving between the testes, and extending anteriorly to the vicinity of the ovary. Pharynx small, 17μ long, the width being almost equal to the length, and situated about 10μ from the oral sucker. Esophagus short and narrow; intestinal ceca simple and extending to the posterior end of the body. Genital pore 100μ to 800μ caudad of the oral sucker; seminal vesicle long, slender, and with muscular walls. Testes globular, 300μ in diameter, situated diagonally in the posterior third of the body. Ovary globular, 150μ in diameter, situated near the equator of the body; receptaculum seminis

large and pedunculated; Laurer's canal present. Vitellaria and Mehlis's gland not yet developed. The uterus passes posteriorly between the testes and then extends anteriorly to the genital pore.

Host.—*Delphinus delphis.*

Location.—Intestine.

Distribution.—Europe.

Remarks.—The specimens upon which Poirier (1886) based the description of the foregoing species were still encysted, the cysts being free in the intestine; they were described as spherical and measured 1 mm in diameter. Looss (1899) referred this species to the genus *Astia*, which he later (1900) renamed *Astiotrema*. Jägerskiöld (1908) pointed out that this form was similar to the species *G. lacteum*, which he had previously described from specimens encysted in the brain of *Cottus scorpius* Bloch. Odhner (1911) was of the opinion that this species was closely related to *G. lacteum*, and Bittner and Sprehn (1928) actually placed it in the genus *Galactosomum* by making the combination of the generic with the specific name.

It seems extremely doubtful whether *G. erinaceum* is a parasite of *Delphinus* in view of the fact that all other members of the genus are parasites of birds. This was pointed out by Jägerskiöld (1908, p. 317), who states: "Wahrscheinlich ist der Delphin nicht der wirkliche Wirt, sondern die von Poirier gefunden Kapseln sind mit irgendwelchen Fische in den Delphin hineingekommen. Der wirkliche Wirt, falls hier wirklich ein Galatosomum vorleight, ist dagegen wahrscheinlich ein fischfressender Meeresvogel."

Family PARAMPHISTOMATIDAE Fischoeder, 1901

Family diagnosis.—Medium-sized to large trematodes, with or without ventral pouch. Cuticle without spines. Oral sucker terminal or in some cases retracted into the body; with or without dorsal pocketlike evaginations; acetabulum at posterior end of body. Pharynx absent; intestinal ceca spacious. Excretory vesicle saclike, opening dorsally a short distance from posterior end of body. Lymph system present. Genital opening ventral, in anterior part of body, with or without genital sucker; cirrus pouch present or absent; testes relatively large, frequently lobed, usually cephalad of ovary. Vitellaria usually well developed. Uterus dorsad of testes. Eggs without filaments. Parasites of mammals, birds, fishes, amphibians, and reptiles.

Type genus.—*Paramphistomum* Fischoeder, 1901.

Genus CHIORCHIS Fischoeder, 1901

Generic diagnosis.—Paramphistomatidae: Body ovoid, convex dorsally and flat to slightly concave ventrally; anterior end somewhat attenuated, posterior end rounded; ventral pouch absent. Oral sucker with paired evaginations, usually retracted into an oral canal by the action of strong muscles attached to the oral sucker; acetabulum circular, near posterior end of body. Esophagus relatively short, thick walled; intestinal ceca terminate at middle of acetabular zone. Excretory vesicle large, cephalad of acetabulum. Genital pore at intestinal bifurcation, surrounded by a poorly developed genital sucker; cirrus pouch absent; seminal vesicle much coiled. Testes X shaped, tandem in position. Ovary posttesticular; Mehlis's gland dorsad of ovary; Laurer's canal opens dorsally in front of excretory pore. Vitellaria extracecal, except near tips of ceca, where a few follicles may be intercecal, and extending from a short distance cephalad of intestinal bifurcation to level of anterior margin of acetabulum. Uterus slightly sinuous, in median line dorsad of testes. Eggs large, thin shelled. Parasites of Sirenia.

Type species.—*Chiorchis fabaceus* (Diesing, 1838) Fischoeder, 1901.

CHIORCHIS FABACEUS (Diesing, 1838) Fischoeder, 1901

PLATE 10, FIGURES 41–45

Synonym.—*Amphistomum fabaceum* Diesing, 1838, p. 189; *Schizamphistoma manati* Sokoloff and Caballero, 1932, pp. 163–167.

Description.—*Chiorchis:* The body is ovoid in outline, 9 mm to 11 mm long by 5 mm wide, ventral surface flat or slightly concave, dorsal surface strongly convex. The oral opening is slightly subterminal and is followed by an oral canal, the length of which depends upon the degree of retraction of the oral sucker. The oral sucker is about 465μ to 800μ in diameter, strongly muscular, and provided with two muscular dorsal pouches. The oral sucker is usually retracted so that its position is about midway between the intestinal bifurcation and the anterior end of the body, the retraction being due to contraction of about 30 muscular bands inserted into the wall of the oral sucker, which radiate posteriorly and attach to the body wall. The acetabulum is ventral, 1.3 mm to 1.8 mm in diameter, situated near the posterior end of the body. The esophagus is relatively long and thick walled, its posterior portion being thickened to form a bulblike structure. The intestinal ceca are spacious and thick walled and extend to about the center of the acetabular zone. The excretory pore is situated in the mid-dorsal line slightly cephalad of the level of the ovary; the excretory vesicle is pouch shaped and relatively thick walled. The lymph system consists of two longitudinal vessels which lie dorsally and medially of the

intestinal ceca and two longitudinal vessels which lie ventrally of the ceca. The dorsal vessels extend the full length of the body and terminate in a number of short, dilated branches. Each vessel gives off about 15 primary branches, which extend lateroventrally and bifurcate to form secondary branches. The secondary branches usually bifurcate to form tertiary branches, each of which terminates in a bulbous swelling near the ventral surface of the body. A number of ventral branches are also given off from the main dorsal canals, but their number and course can not be determined with certainty. The ventral longitudinal canals extend the full length of the intestinal ceca and give off a number of branches, both medially and laterally, which branch again and again and finally terminate in large bulbous swellings; these branches and swellings cover the entire ventral surface of the body beneath the dermomuscular layer. The genital pore is situated immediately caudad of the intestinal bifurcation and is surrounded by a weakly muscular genital sucker. In immature specimens the suckerlike arrangement of the muscular fibers is not so distinct as in more mature specimens. The genital opening communicates with a genital sinus into which projects the prominent genital papilla. The greatly convoluted seminal vesicle lies free in the parenchyma dorsad of the genital pore. The proximal portion of the ejaculatory duct is inclosed in a muscular saclike structure, but distally this sac is very feebly developed or absent. The ejaculatory duct unites with the vagina or metraterm to form a hermaphroditic canal, which opens into the genital sinus at the summit of the genital papilla. The testes are X shaped in mature specimens and almost spherical in immature specimens; they are situated in the median field and are tandem in position. The ovary is almost spherical, about 30μ in diameter, median in position, and situated about midway between the posterior testis and acetabulum. Mehlis's gland well developed, dorsad of ovary. Laurer's canal is very slender and opens in the mid-dorsal line a short distance cephalad of the excretory pore. The vitellaria are extracecal, except for a few follicles, which are distributed intercecally immediately in front of the acetabulum, and extend anteriorly beyond the intestinal bifurcation. The uterus extends anteriorly in the median line, dorsal to testes, to the level of the cephalic margin of the anterior testis, and then turns ventrally and terminates in a weakly muscular vagina or metraterm. The proximal portion of the uterus may be filled with spermatozoa, and constitutes a receptaculum seminis uterinum. The eggs are oval, about 150μ long by 90μ wide, and thin shelled.

Hosts.—*Manatus exunguis* Natterer (=? *Trichechus inunguis* Pelzeln), *Trichechus latirostris* (syn. *Manatus latirostris*), and *T. senegalensis*.

Location.—Large intestine.

Distribution.—North America (Philadelphia Zoological Garden; National Zoological Park, Washington, D. C.; Mexico), South America (Brazil), and Africa (Belgian Congo).

Remarks.—The above description is based largely upon specimens (U.S.N.M. Helm. Coll. No. 24716), collected at Washington, D. C., July 16, 1921, by Dr. E. A. Chapin, these flukes being well preserved and fully mature. Other specimens available for comparison consisted of three lots as follows: U.S.N.M. Helm. Coll. No. 5775, from the Leidy collection, probably a part of the specimens described by Leidy (1891); U.S.N.M. Helm. Coll. No. 18425, collected at Washington, D. C., November 14, 1916, by Dr. L. T. Giltner; and U.S.N.M. Helm. Coll. No. 8416, labeled "F. 1063, *Chiorchis fabaceus* Dies., stomach and intestine, *Manatus senegalensis*, Banana, Aug. 1915." The last-named material is from the MacCallum collection and represents a part of the lot of specimens described by Stunkard (1930).

All the specimens examined from these different collections agree in general with the description given for *Chiorchis fabaceus* by Fischoeder (1903). The majority of the specimens, however, were immature and smaller than the ones upon which the above description is based, and considerable variation was found to exist, especially as regards the shape of the testes. The Leidy specimens were the most immature, and in these the testes varied in shape from spherical to very slightly lobed, none showing the typical X-shaped testes characteristic of the species. They agree, however, in all other respects and must be regarded as the same species as those of the other lots which correspond more closely to the description given by Fischoeder.

Family NOTOCOTYLIDAE Lühe, 1909

Family diagnosis.—Small to medium-sized monostomes; body usually elongate, tapering anteriorly and rounded posteriorly. Ventral surface usually concave, with or without longitudinal rows of glands or ridges. Oral sucker terminal; pharynx absent; esophagus short; intestinal ceca slender, usually provided with short diverticula. Excretory pore dorsal, near posterior end of body; excretory vesicle with short stem and long branches, which unite near anterior end of body. Genital pore median and situated in anterior part of body, except in *Nudacotyle* where it is lateral and in posterior part of body; cirrus pouch elongate; testes postequatorial, in same transverse plane, usually extracecal. Ovary between testes; Mehlis's gland complex preovarial; vitellaria lateral, pretesticular;

uterine coils transverse, regular, pretesticular. Eggs small and provided with a long filament at each pole. Parasites of birds and mammals.

Type genus.—*Notocotylus* Diesing, 1839.

Subfamily OGMOGASTERINAE Kossack, 1911

Subfamily diagnosis.—Notocotylidae: Ventral surface of body provided with longitudinal ridges or rugae. Uterine coils extend anteriorly beyond base of cirrus pouch. Parasites of cetaceans and pinnipeds.

Type genus.—*Ogmogaster* Jägerskiöld, 1891.

Genus OGMOGASTER Jägerskiöld, 1891

Generic diagnosis.—Ogmogasterinae: Body oval, flattened, and leaflike, margins fluted; ventral surface provided with longitudinal ribs or rugae. Oral sucker terminal; esophagus short; intestinal ceca slender and extending to posterior end of body. Genital aperture median, a short distance caudad of oral sucker; cirrus and vagina open into a short genital sinus. Cirrus pouch long, situated in median line and extending posteriorly to near equator of body; testes deeply lobed, situated in the same transverse plane in the posterior fourth of body. Ovary lobed, median in position and situated at the level of the posterior margin of testes; Mehlis's gland median, preovarial; Laurer's canal present; vitellaria lateral, consisting of isolated follicles and extending from anterior margin of testes to level of the base of the cirrus pouch; uterus greatly convoluted, the coils extending laterally beyond intestinal ceca. Parasites of cetaceans and pinnipeds.

Type species.—*Ogmogaster plicatus* (Creplin, 1829) Jägerskiöld, 1891.

OGMOGASTER PLICATUS (Creplin, 1829) Jägerskiöld, 1891

PLATE 12, FIGURE 52

Synonym.—*Monostomum plicatum* Creplin, 1829, pp. 878–880.

Description.—*Ogmogaster:* Body oval, 6 mm to 14 mm long by an average width of 4 mm, flat and leaflike; the margins of the body have a fluted or pleated appearance, and the ventral surface is provided with 15 to 17 longitudinal rugae. Oral sucker terminal, 500μ in diameter, according to Leiper and Atkinson (1915); esophagus short; intestinal ceca sinuous and terminating near the posterior end of the body. Excretory pore dorsal, about 700μ from the posterior end of body, according to Jägerskiöld; excretory vesicle

Y shaped, situated ventral to ovary and testes. The limbs of the vesicle extend anteriorly and unite at the level of the intestinal bifurcation at which point two branches are given off, one on each side, which extend posteriorly in the lateral fields, then turn and pass anteriorly to the level of the oral sucker, where they again turn and pass backward and terminate near the posterior end of the body. Long branches are given off here and there along the course of the excretory ducts. Genital aperture median, situated a short distance caudad of the oral sucker; the male and female genital pores are situated side by side at the base of a short genital sinus. Cirrus pouch cylindrical, 3 mm long by 300μ wide, containing a seminal vesicle, 1.4 mm long by 200μ wide, and a long convoluted ejaculatory duct. The ejaculatory duct is lined with a membrane, which is closely beset with small papillalike projections; it may be protruded as a slender cirrus the length of which may equal the length of the body, according to Creplin (1829). Testes deeply lobed, 1 mm long by 1.1 mm wide, situated in the same transverse plane in the posterior fourth of the body; vasa efferentia short, uniting to form a relatively wide vas deferens which extends anteriorly in the median line to the base of the cirrus pouch; it then passes to the right of the cirrus pouch where it makes several loops, four to five according to Jägerskiöld, and then passes backward and enters the base of the cirrus pouch. Ovary deeply lobed, 500μ long by 1 mm wide, situated between the testes; Mehlis's gland preovarial; Laurer's canal present. Vitellaria lateral, composed of 12 to 16 isolated follicles on each side, lying ventral to ceca, and extending from the anterior margin of the testes to about the level of the base of the cirrus pouch. Uterus slender and greatly convoluted, extending laterally beyond the ceca and from the testes anteriorly to about one-fourth of the body length from the anterior end. Vagina muscular and lined with spines which are about 35μ long. Eggs elongate oval in shape, 25μ long, and provided with a long filament at each pole.

Hosts.—Cetacea (*Balaenoptera borealis*, *B. musculus* = *B. physalus*, *B. acutorostrata*=*Balaena rostrata*); Pinnipedia [2] (*Leptonychotes weddellii*, *Lobodon carcinophaga*).

Location.—Intestine.

Distribution.—Europe (Norway); Antarctic waters (vicinity of Cape Evans).

Remarks.—The above description is taken largely from an exhaustive description of this species given by Jägerskiöld (1891).

[2] Johnston (1931) regards the form from pinnipeds as a species distinct from *Ogmogaster plicatus*. The new species, for which he proposes the name *O. antarcticus*, differs from *O. plicatus* in "its smaller size, different body proportions, presence of only 13 rugae, more restricted vitelline zone, and relatively smaller cirrus sac."

Family RHABDIOPOEIDAE Poche, 1926

Family diagnosis.—Body elongated, rounded at each end, convex dorsally and concave ventrally. Cuticle of ventral surface armed with large, curved, hooklike spines. Posterior end of body provided with large cavity opening dorsally, containing a number of proboscislike, protrusible structures. Excretory pore situated in the floor of the proboscid cavity; excretory vesicle with four anteriorly directed limbs, two lateral and two median; the lateral pair of branches unite near the intestinal bifurcation and possess short lateral diverticula; the median branches are intercecal and terminate blindly near intestinal bifurcation. Oral sucker subterminal; esophagus slender; intestinal ceca pass between testes and unite at posterior end of body. Genital aperture situated at side of oral sucker; cirrus pouch long and slender, containing a portion of seminal vesicle. Testes extracecal, situated in the same transverse plane near the posterior end of body. Ovary between testes; seminal receptacle and Laurer's canal absent. Vitellaria extracecal and posttesticular. Uterus long and slender, with numerous transverse loops extending beyond lateral limits of the intestinal ceca; vagina as long as cirrus pouch. Eggs small, provided with a long filament at each pole. Parasitic in Sirenia.

Type genus.—*Rhabdiopoeus* S. J. Johnston, 1913.

Genus RHABDIOPOEUS S. J. Johnston, 1913

Generic diagnosis.—Rhabdiopoeidae: Characters of the family.

Type species.—*Rhabdiopoeus taylori* S. J. Johnston, 1913.

RHABDIOPOEUS TAYLORI S. J. Johnston, 1913

PLATE 12, FIGURE 51

Description.—*Rhabdiopoeus:* Body elongated and lancelike, 22 mm long by 5 mm wide; thinner anteriorly than posteriorly; dorsal surface convex; ventral surface flat or slightly concave anteriorly and more deeply concave posteriorly. The ventral surface is covered with large, recurved, hooklike spines, 107μ long by 64μ wide at their bases; they are set in a thick cuticula. Oral sucker almost circular, 733μ in diameter, subterminal and directed ventrally; esophagus moderately long; intestinal ceca slender, united at posterior end of body; small lateral ceca are present along the posttesticular portions, but absent elsewhere along their course. A large cavity, opening dorsally, is present near the posterior end of the body; this cavity communicates with nine tunnel-like tubular spaces, three of which are anterior and the remaining six are arranged in

two lateral groups of three, each containing a protrusible fingerlike proboscis. The excretory pore is situated in the floor of the proboscid chamber; excretory vesicle large and branched, each of the branches becoming narrowed into 1 of the 4 chief trunk vessels, 2 of the vessels being median and 2 lateral. The lateral vessels extend anteriorly, lateral of testes, and unite immediately anterior and ventral of the intestinal bifurcation; they are provided with short lateral branches along their course from the level of the anterior margin of the testes to the level of the intestinal bifurcation. The two median vessels pass between the testes and extend anteriorly in the intercecal field to near the intestinal bifurcation where they terminate blindly. Genital aperture near right margin of oral sucker. Cirrus pouch long and slender, its posterior end lying in the median line about one-fourth of the body length from the anterior end; it contains a small portion of the seminal vesicle, an ejaculatory duct surrounded by prostate cells, and a muscular cirrus. Testes deeply lobed, about 2 mm long by 940μ wide, situated in the same transverse plane near the junction of the third and last body fourths; they are so situated that their long axes are oblique to the long axis of the body, their bases being separated by the intestinal ceca. The vas deferens is expanded to form a relatively wide seminal vesicle which extends anteriorly in a more or less tortuous course from the level of the anterior margin of the testes to the cirrus pouch. Ovary oval, 890μ long by 570μ wide; Mehlis's gland 820μ long by 490μ wide, situated to the right of ovary; both ovary and Mehlis's gland lie in the angle formed by the testes. There is no seminal receptacle or Laurer's canal. Vitellaria extracecal and posttesticular in position, and consisting of grapelike groups of oval follicles, each lateral mass being composed of about 50 groups. Uterus long and slender, composed of numerous, closely packed transverse loops which extend laterally beyond the limits of the ceca as far as the lateral branches of the excretory system. Eggs 26μ long by 15μ wide, thin shelled, and with a long filament at each pole.

Host.—*Halicore dugong.*

Location.—Intestine.

Distribution.—Australia (coast of Queensland).

Family OPISTHOTREMATIDAE Poche, 1926

Family diagnosis.—Body spoon shaped; ventral surface spiny. Esophagus moderately long, slender; intestinal ceca without diverticula. Excretory pore dorsal; excretory vesicle short and with lateral branches. Genital openings median and situated almost at extreme posterior end of body. Cirrus pouch long and slender, median, containing a strongly convoluted seminal vesicle and a protrusible

cirrus; testes intercecal or extracecal, situated in the same transverse plane in the posterior part of body. Ovary either dextral or sinistral in position, pretesticular; Mehlis's gland postovarial; seminal receptacle present; Laurer's canal present or absent; vitellaria weakly developed, intercecal, pretesticular; uterus long and slender, occupying the greater portion of the central part of body, usually confined to the intercecal field. Eggs with long polar filaments. Parasites of respiratory passages of Sirenia.

Type genus.—*Opisthotrema* Fischer, 1883.

KEY TO THE GENERA OF OPISTHOTREMATIDAE

1. Testes extracecal ---------------------------------- **Opisthotrema** (p. 49).
   Testes intercecal ---------------------------------- **Pulmonicola** (p. 55).

Genus OPISTHOTREMA Fischer, 1883

Synonym.—*Cochleotrema* Travassos and Vogelsang, 1931.

Generic diagnosis.—Opisthotrematidae: Body oval to piriform in shape, flattened dorsoventrally, dorsum strongly arched and venter strongly concave; margin of body may or may not be provided with a muscular rim. Cuticle of ventral surface spiny. Oral sucker ventral, situated a short distance from the anterior margin of body; pharynx absent; esophagus slender and of medium length; intestinal ceca more or less sinuous and extending into the posterior fourth of body. Excretory pore dorsal and somewhat removed from the posterior margin; excretory vesicle tubular and provided with lateral branches. Genital pores at posterior end of body; cirrus pouch long and slender, containing a slender, convoluted seminal vesicle and a long, slender, protrusible cirrus; testes lobed, situated extracecally in the same transverse plane in the posterior part of body. Ovary lobed, to the right or left of the median line anterior to and separated from the testis on the corresponding side by the intestinal cecum, which passes between them; Mehlis's gland well developed; seminal receptacle present; Laurer's canal present or absent; vitellaria intercecal and consist of a grapelike mass of follicles on each side of median line, or of a mass of irregular follicles in the median field. Uterus long, slender, and convoluted, occupying the greater part of the central portion of the body; vagina long, slender, slightly sinuous, and provided with relatively strong muscular walls. Eggs oval and provided with a slender filament at each pole. Parasites of the respiratory tract and eustachian tubes of Sirenia.

Type species.—*Opisthotrema cochleare* Fischer, 1883 (=*Monostomum dujonis* Leuckart, 1874).

Remarks.—The foregoing diagnosis is based on the characters common for the two species which are described later. The writer

recognizes the genus *Pulmonicola*, which was proposed by Poche (1926), as distinct from the genus *Opisthotrema* on the ground that the intercecal position of the testes in *Pulmonicola pulmonalis* is too great a difference to be regarded as being a character of only specific value.

KEY TO THE SPECIES OF THE GENUS OPISTHOTREMA

1. Body piriform in outline; distinct muscular rim absent; intestinal ceca relatively wide, their blind ends diverging__ dujonis (p. 50).
   Body oval in outline; distinct muscular rim present; intestinal ceca slender, their blind ends converging___________ cochleotrema (p. 52).

OPISTHOTREMA DUJONIS (Leuckart, 1874), new combination

PLATE 11, FIGURE 46

Synonyms.—*Monostomum dujonis* Leuckart, 1874, p. 419; *Opisthotrema cochleare* Fischer, 1883, pp. 1–42.

Description.—*Opisthotrema:* Body piriform in outline, 9 to 11 mm long by 5 mm wide; the dorsal surface is strongly convex and the ventral surface concave, which gives the body the appearance of the bowl of a spoon. Cuticle spiny on ventral surface, according to Fischer, and also on anterior part of dorsal surface, according to Johnston (1913). Oral sucker ventral, 600μ long by 850μ wide, situated about 460μ from the anterior end of body; esophagus slender, about 1 mm long by 80μ wide; intestinal ceca relatively wide, slightly sinuous and extending to near the posterior end of the body, their blind ends somewhat distended and diverging. The excretory system consists of two canals, one on each side, united by a commissure a short distance caudad of the intestinal bifurcation and again by a similar commissure about midway between the intestinal bifurcation and the posterior margin of the oral sucker. Each of the canals is provided with lateral branches, which extend to the margin of the body. Excretory vesicle (?); excretory pore (?). According to Fischer, the canals terminate near the ends of the ceca and probably open separately. The cirrus pouch is cylindrical, 2 mm long by 245μ wide, situated in the median line in the posterior part of the body, containing a greatly convoluted seminal vesicle and a slender protrusible cirrus; genital pore ventral, near posterior margin. Testes lobed, 250μ to 540μ in diameter, situated in the same transverse plane and extracecal in position. Ovary small, lobate, situated to the left of the median line and a short distance cephalad of the level of the testes; Mehlis's gland small, caudad of ovary; Laurer's canal present, the proximal part of the canal being expanded

to form a seminal receptacle measuring 170μ long by 57μ wide. Vitellaria weakly developed, consisting of a few follicles situated along the vitelline duct at each side of the intercecal field. Uterus slender and occupying the intercecal space in the equatorial third of the body; during its course the uterus describes a number of loops which form a treelike pattern. The distal portion of the uterus is expanded to form an egg reservoir and continues as a slender vagina, which opens beside the male genital aperture. Eggs oval in outline, 29μ long by 9μ wide, provided with a long, slender filament at each pole.

Host.—*Halicore dugong.*

Location.—Eustachian tubes and esophagus.

Distribution.—Philippine Islands; Australia.

Remarks.—This species was named *Monostomum dujonis* by Leuckart (1874) in a review of Zeller's (1874) paper "Uber *Leucochloridium paradoxum* Carus and die weitere Entwickelung seiner Distomenbrut." In this review, Leuckart, in commenting on the genital system of *L. paradoxum*, stated: "Und seine Generationsorgane in allen ihren Theilen vollstandig und deutlich erkennen lässt. Die Ausmündung derselben liegt, wie sonst nur bei wenigen Distomeen—Ref. kennt auch ein Monostomum, das sich ganz ähnlich verhält, *M. dujonis*, das Semper in den Eustachischen Röhren des Dujung der Philippinen sammelte und dem Ref. freundlichst zur Untersuchung uberlassen hat—an Hinterende des Körpers, dicht neben der des excretorischen Apparates." Fischer's (1883) description of *Opisthotrema cochleare* is based unquestionably upon a study of the specimens which Leuckart referred to, since he stated in the introduction of his paper: "Besagte Form wurde von Herrn Prof. Semper in Würtzburg auf seiner Expedition nach den Philippinen gesammelt. Sie entstammt der Paukenhöhle von Halicore Dugong."

The name given to this worm by Leuckart can not be regarded as a *nomen nudum* because an important morphological character, the position of the genital pore, is pointed out and in addition are given the host and habitat of the species. It is, therefore, the opinion of the writer that the correct name for this species is *Opisthotrema dujonis* (Leuckart), since the rules of zoological nomenclature state: "Art. 25.—The valid name of a genus or species can be only that name under which it was first designated on the condition: a) That this name was published and accompanied by an indication, or a definition, or a description;" etc. The description given by Leuckart is more in the form of a comparison than an actual description, but it appears sufficient to fix the specific name, since the rules do not state how much description should be given.

OPISTHOTREMA COCHLEOTREMA (Travassos and Vogelsang, 1931[3]) new combination

PLATE 11, FIGURE 47–49

Synonyms.—Amphistomum fabaceum Diesing of Leidy, 1891, pp. 413–414, in part; *Opisthotrema cochleare* Fischer of Stiles and Hassall, 1894, p. 253; *Cochleotrema cochleotrema* Travassos and Vogelsang, 1931, pp. 143–146.

Description.—Opisthotrema: The body is oval in outline, 8.5 mm long by 6.5 mm wide, strongly concave ventrally and convex dorsally; the margin of the body is surrounded by a more or less delicate muscular rim, which is about 250μ wide. The strongly convexo-concave condition of the body suggests that the entire worm attaches itself to the mucous membrane in the manner of a vacuum cup, the muscular rim serving as a sort of seal. The cuticle of the ventral surface is covered with scalelike spines, 7μ long by 4μ wide, arranged in irregular alternating rows. The excretory pore is situated dorsally, about 930μ from the posterior end of the body, the aperture being surrounded by a muscular sphincter. The excretory vesicle is tubular, about 1 mm long, and is provided with two principal branches on each side; the first branch occurs at the level of the blind ends of the ceca and the other at the anterior end of the vesicle; two smaller branches are given off on each side a short distance caudad of the anterior branches. The remainder of the excretory system could not be worked out in detail, but judged from sections the course of the principal branches is probably similar to that described by Fischer for *O. cochleare*. The oral sucker is transversely oval, 1 mm long by 1.3 mm wide, strongly muscular, and situated ventrally about 465μ from the anterior margin of the body; it is deeply imbedded in the parenchyma and projects only slightly beyond the ventral surface. The esophagus is slender and about 465μ long; the intestinal ceca are slender and serpentine, 155μ wide, the blind ends converging toward the median line. Cirrus pouch slender, about 3 mm long by 155μ wide at the level of the testes; the walls are moderately thick

[3] This species was described by the writer as new in the present paper, but while the manuscript was awaiting publication a description appeared by Travassos and Vogelsang (1931) of a species from *Trichechus manatus* which appears to be the same form. The description given herein is from the writer's specimens. Some slight differences exist between this and the description given by Travassos and Vogelsang, but these differences appear to be those of interpretation. Travassos and Vogelsang note that in their specimens the ventral surface is covered with small papillae similar to those occurring on the ventral surface of *Gastrodiscus*, and that Laurer's canal is present. In the specimens at the writer's disposal the ventral surface is covered with small triangular, scalelike spines (pl. 11, fig. 49) and no Laurer's canal is present. The absence of Laurer's canal is shown in pl. 11, fig. 48, which is a reconstruction from serial sections.

The writer does not agree with Travassos and Vogelsang as to the necessity of creating a new genus for this species, since the differences between this species and the type of the genus are too slight to warrant such action.

and muscular, both circular and longitudinal fibers being present. The seminal vesicle is slender and greatly convoluted, and occupies the basal third of the cirrus pouch. A definite pars prostatica appears to be absent although some prostate cells are present along the distal, less convoluted portion of the seminal vesicle. The cirrus is slender, about 2 mm long, unarmed and protrusible. The genital aperture is ventral and situated at the posterior end of the body at the junction of the muscular rim with the body proper. The testes are deeply lobed, about 850μ by 620μ, extracecal and opposite each other in the posterior third of the body. The ovary is irregular in outline but not deeply lobed, about 435μ in diameter, situated to the right of the median line, intercecal and pretesticular. Mehlis's gland is composed of large piriform cells and is situated median and slightly dorsal to the ovary. The seminal receptacle is muscular, more or less oblong, about 697μ long by 155μ wide, and situated dorsal to Mehlis's gland. There is no Laurer's canal. The vitellaria consist of relatively few, large, irregularly shaped follicles situated in the intercecal space between the equator of the body and the testes; the follicles are not divided into two separate groups as in *O. dujonis*, but form a single, more or less grapelike mass. The uterus is greatly convoluted, forming a wreathlike mass of loops which occupies the greater part of the central portion of the body; the loops extend slightly beyond the ceca laterally, but do not extend anteriorly beyond the intestinal bifurcation. The terminal portion of the uterus is continued as a muscular walled, slightly sinuous vagina or metraterm, which runs dorsal to the cirrus pouch and opens beside the male genital aperture. The eggs are oval in shape, 18μ long by 11μ wide, light straw colored, and provided with a long, slender filament at each pole.

Hosts.—*Trichechus manatus* and *T. latirostris* (=*Manatus latirostris.*)

Location.—Nasal passages and stomach.

Distribution.—North America (United States—Philadelphia, Pa.), and Tropical America.

Specimens.—U.S.N.M. Helm. Coll. No. 1732.

Remarks.—In a note presented at a meeting of the Philadelphia Academy of Natural Sciences, Leidy (1891) reported the occurrence of *Amphistomum fabaceum* Diesing in a sea cow, *Manatus latirostris*, which died in the zoological garden. These specimens had been collected from the large intestine and submitted by Dr. H. C. Chapman. In the same note he said: "Numerous specimens, many of larger size, up to 11 mm long by 9 mm broad, were obtained from the nasal passages of another sea cow, and were presented to the Academy by Jacob Geismar."

Stiles and Hassall (1894) examined the trematodes of the Leidy collection and redetermined the specimens reported from the nasal passages as *Opisthotrema cochleare* Fischer. A part of the material, two specimens, was retained in the United States National Museum collection, and it is upon these that the foregoing description of *Opisthotrema cochleotrema* is based.

These specimens are sexually mature, but somewhat smaller than those reported by Leidy. One of them was stained and mounted whole; the other was stained and sectioned. The description given above is a composite one, the details being obtained from the sectioned specimen.

Opisthotrema cochleotrema differs in a number of respects from *O. dujonis* (Leuckart) (=*O. cochleare* Fischer), so that there appears to be no doubt that they are distinct species. *O. cochleotrema* is provided with a muscular rim similar to that described for *Pulmonicola pulmonalis* (von Linstow); the intestinal ceca are slender and uniform in diameter, serpentine, and their blind ends converge; Laurer's canal is absent; and the terminal part of the uterus is not expanded to form an egg reservoir. In *O. dujonis* the body is not provided with a muscular rim; the intestinal ceca are not of uniform width, only slightly sinuous, and their blind ends diverge; Laurer's canal is present; and the distal part of the uterus is expanded to form an egg reservoir. Other differences may be easily seen by comparing the descriptions and figures of the two species.

Fischer's (1883) figure of *Opisthotrema cochleare* (=*O. dujonis*) leaves the impression that the principal branches of the excretory system open separately and in this connection he states "indem wahrscheinlich nicht eine, sondern zwei Mündungsstellen vorhanden dürften, die der ventralen Seite angehören und jederseits unterhalb der Darmschenkel liegen." Poche (1926) doubts the presence of two excretory pores in this species, but Fuhrmann (1929) believes that two openings should be present and has indicated in the figure of *O. cochleare* ("nach Fischer") just where these openings should be located. The study of serial sections of *O. cochleotrema* has shown that the position of the excretory pore in this species is essentially the same as that in members of the family Notocotylidae[4] and Pronocephalidae. In view of this fact it appears reasonable to assume that the position of the excretory pore in *O. dujonis* will be

[4] In Poche's (1926) classification of the trematodes, the monostomes belonging to the families Notocotylidae, Pronocephalidae, Opisthotrematidae, and Rhabdiopoeidae are placed in the super-superfamily Notocotylida. Since groups of the rank of super-superfamily have not been recognized by helminthologists and are unnecessary at present, the writer proposes at this time the new superfamily Notocotyloidea, to replace the super-superfamily Notocotylida Poche.

found to be the same as that in *O. cochleotrema*, as it would be unusual to find such marked differences in two species so closely related.

Genus PULMONICOLA Poche, 1926

Generic diagnosis.—Opisthotrematidae: Entire margin of body, except space occupied by oral sucker, provided with a muscular rim. Cuticle without spines. Oral sucker ventral, near anterior margin of body; intestinal ceca straight, uniform in diameter. Excretory system (?), probably similar to that in *Opisthotrema.* Testes entire, intercecal, situated near ends of ceca. Ovary median. Other characters as in *Opisthotrema.*

Type species.—*Pulmonicola pulmonalis* (von Linstow, 1904) Poche, 1926.

PULMONICOLA PULMONALIS (von Linstow, 1904) Poche, 1926

PLATE 11, FIGURE 50

Synonyms.—*Opisthotrema pulmonale* von Linstow, 1904, pp. 678–680.

Description.—*Pulmonicola:* Body oval in outline, 5.13 mm long by 3.95 mm wide; margin of body, except for the portion occupied by the oral sucker, modified to form a muscular rim. Oral sucker situated on ventral surface, 330μ from the anterior margin; esophagus very slender, 180μ long by 28μ wide; intestinal ceca uniform in diameter and extending into the posterior fourth of body. Cirrus pouch slender, spirally coiled distally, and containing a greatly convoluted seminal vesicle. Testes oval, entire, 390μ long by 280μ wide, situated intercecally in the same transverse plane. Ovary small, median in position, situated a short distance caudad of the equator of body; Mehlis's gland smaller than ovary and situated immediately caudad of it; receptaculum seminis present; Laurer's canal present. Vitellaria in intercecal field and consisting of a few isolated follicles situated between the ovary and testes. Uterus slender, intercecal, occupying the equatorial third of body in immature specimens, but in mature specimens more convoluted and occupying the second and third fourths of the body; vagina dorsal to cirrus pouch; genital pore at posterior end of body. Eggs 16μ long by 9μ wide, yellow in color, and provided with a long filament at each pole.

Hosts.—*Halicore australe*, *H. dugong.*

Location.—Lung.

Distribution.—Australia (Torres Straits).

SPECIES OF UNCERTAIN POSITION

DISTOMA ANDERSONI Cobbold, 1876

PLATE 12, FIGURE 53

Description.—" Body oblong, smooth externally, uniform in thickness, six times as long as broad; head with lateral projections; ventral sucker large and prominent; neck much constricted; tail evenly rounded off, blunt. Length 1/8″, breadth about 1/50″. The testes are globular and placed high up in the middle line of the body. The small lobed gland immediately above them is probably the ovary. The clear narrow line extending from the border of the lower testis to the end of the tail seems to mark the limit of the vitellogene organs on either side below. These glands in all likelihood extend upwards to the neck, being apparently very largely developed in this species."

Host.—*Platanista gangetica.*

Location.—Small intestine.

Distribution.—Asia (India).

Remarks.—The foregoing description, copied from Cobbold (1876), was based upon a drawing sent to him by Dr. John Anderson, superintendent of the Indian Museum, Calcutta. Odhner (1905) believed that this worm was probably related to *Brachycladium* (=*Campula*), as he stated: " Endlich finde ich sehr wahrscheinlich, dass das sehr ungenügend bekannte *Dist. andersoni* Cobb. aus *Platanista gangetica* sich bei genauerer Untersuchung als eine *Brachycladium*-Art entpuppen wird." It is probably unwise to venture an opinion as to the systematic position of this species, but certain features as shown in the drawing, assuming that the sketch was not made from a mutilated specimen, suggest that this form might be an echinostome. The anterior end is not unlike the cephalic collar of the echinostomes; the small oral sucker and the large acetabulum, as well as the relative size and position of the ovary and testes, suggest such affinities. On the other hand, what is figured as the oral sucker may be only the oral aperture, and the structure which resembles a cephalic collar may in reality be the oral sucker which has been torn loose from the body.

DISTOMUM PHILOCHOLUM Creplin, 1845

Description.—None.

Host.—*Delphinus delphis.*

Location.—Liver.

Distribution.—Europe.

Remarks.—Creplin (1845) gives only the name and habitat of this species, and for this reason it must be regarded as a *nomen nudum.*

AGAMODISTOMUM DELPHINI (Diesing, 1850), new combination

Synonyms.—*Monostomum delphini* Diesing, 1850, p. 390; *Monostomum blainvillei* Cobbold, 1860, p. 39; *Monostomulum delphini* (Diesing, 1850) Brandes, 1892, p. 510.

Description.—The following is the only existing description of this worm and is quoted verbatim from de Blainville (1825):

En enlevant la graisse de cet animal [a whale], on a trouvé, enfermé dans son épaisseur, et contenu dans une sorte de kyste à parois lisses en dedans, mais non distinctes en dehors, un ver assez singulier, que M. de Blainville crut d'abord pouvoir rapporter au genre Monostome, mais qui en diffère sensiblement, comme on va le voir; il était replié dans son kyste, et vivant, quoique le dauphin fût mort depuis cinq ou six jours. Mis dans de l'eau froide, il se contractait dans tous les sens, de maniere à présenter une form extrèmement variable, quelquefois globuleuse, d'autres fois ovale-alongée, ctranglée au milieu ou nouée, avec une sorte de queue en arrière ou de tube en avant; son extrémité anterieure souvent atténuée et cylindrique, présentait un orifice évident de form circulaire. Il en existait aussi un autre a l'extrémité postérieure, mais beaucoup plus petit, et au milieu d'une sorte d'auréole plus grise; enfin, sur un individu, M. de Blainville a vu, à peu près à la moité de la longueur et en dessous, une petite masse blanche, ovale, saillante en dehors, un peu comme dans les fascioles, ou distomes. Ce ver, d'une couleur blanche mate, était formé d'une sorte d'enveloppe épaisse de cette couleur, et d'une autre intestinale comme gélatineuse.

Host.—*Delphinus dalei* (probably=*Mesoplodon bidens*).

Location.—Encysted in fat.

Distribution.—Europe (Havre, France).

Remarks.—Diesing (1850) regarded this species as an immature monostome, as did Cobbold (1860) and Brandes (1892). The description and habitat, however, do not sustain this assumption. So far as known, the true monostomes do not encyst as larvae in the body of vertebrates, but encyst in water and become attached to herbage or other objects, or remain floating. Certain features of this form as given in de Blainville's description, especially the small, oval projection on the ventral surface situated about the middle of the body (à peu près à la moité de la longeur et en dessous, une petite masse blanche, ovale, saillante en dehors), suggest that this worm is the metacercaria of a species of *Alaria* or that of a related genus, the oval body corresponding to the holdfast organ of these forms. This species, therefore, has been transferred to the collective distome genus *Agamodistomum*.

LIST OF TREMATODES ARRANGED ACCORDING TO HOSTS[5]

Order CETACEA

Suborder MYSTICETI

Family BALAENIDAE

Balaena mysticetus:
Lecithodesmus goliath (van Beneden).

Family BALAENOPTERIDAE

Balaenoptera acutorostrata (syn. *B. rostrata*):
Fasciola hepatica Linnaeus.
Lecithodesmus goliath (van Beneden).
Ogmogaster plicatus (Creplin).
Balaenoptera borealis:
Lecithodesmus goliath (van Beneden).
Ogmogaster plicatus (Creplin).
Balaenoptera physalus (syn. *B. musculus* Companyo):
Ogmogaster plicatus (Creplin).

Suborder ODONTOCETI

Family DELPHINIDAE

Delphinus delphis:
Campula delphini (Poirier).
Campula palliata (Looss).
Campula rochebruni (Poirier).
Galactosomum erinaceum (Poirier).
Distomum philocholum Creplin.
Tursiops truncatus (syn. *Delphinus tursio*):
Synthesium tursionis (Marchi).
Orcinus orca (syn. *Orca gladiator*):
Fasciola hepatica Linnaeus.
Orcaella brevirostris:
?*Amphimerus lancea* (Diesing).
Phocaena phocoena (syn. *P. communis*):
Campula oblonga Cobbold.
Opisthorchis tenuicollis (Rudolphi).
Pholeter gastrophilus (Kossack).
Sotalia tucuxi (syn. ? *Delphinus tacuschi*).
Amphimerus lancea (Diesing).
Delphinapterus leucas:
Hadwenius seymouri, new species.

Family PLATANISTIDAE

Platanista gangetica:
Cyclorchis campula (Cobbold).
Distoma andersoni Cobbold.

Family ZIPHIIDAE

Mesoplodon bidens (syn. ? *Delphinus dalei*):
Agamodistomum delphini (Diesing).

Order SIRENIA

Family TRICHECHIDAE

Trichechus inunguis (syn. ? *Manatus exunguis* Natterer):
Chiorchis fabaceus (Diesing).
Trichechus latirostris:
Chiorchis fabaceus (Diesing).
Opisthotrema cochleotrema (Travassos and Vogelsang).
Trichechus manatus:
Opisthotrema cochleotrema (Travassos and Vogelsang).
Trichechus senegalensis:
Chiorchis fabaceus (Diesing).

Family HALICORIDAE

Halicore dugong (syn. *H. cetacea*):
Opisthotrema dujonis (Leuckart).
Rhabdiopocus taylori S. J. Johnston.
Pulmonicola pulmonale (von Linstow).
Halicore australe:
Pulmonicola pulmonale (von Linstow).

[5] The writer is indebted to Dr. Remington Kellogg, assistant curator of the division of mammals of the United States National Museum, for suggesting the probable identifications of the hosts.

Order PINNIPEDIA

Family OTARIIDAE

Zalophus californianus:
- *Apophallus zalophi*, new species.
- *Zalophotrema hepaticum* Stunkard and Alvey.
- *Stephanoprora denticulata* (Rudolphi).

Family PHOCIDAE

Phoca groenlandica:
- *Pseudamphistomum truncatum* (Rudolphi).

Phoca hispida (syn. *Halichoerus foetidus*):
- *Orthosplanchnus arcticus* Odhner.
- *Phocitrema fusiforme* Goto and Ozaki.
- *Pseudamphistomum truncatum* (Rudolphi).

Phoca vitulina:
- *Apophallus donicus* (Skrjabin and Lindtrop).
- *Cryptocotyle lingua* (Creplin).
- *Echinostoma acanthoides* (Rudolphi).
- *Pseudamphistomum truncatum* (Rudolphi).

Erignathus barbatus (syn. *Phoca barbata*):
- *Opisthorchis tenuicollis* (Rudolphi).
- *Orthosplanchnus arcticus* Odhner.
- *Orthosplanchnus fraterculus* Odhner.

Halichoerus grypus:
- *Metorchis albidus* (Braun).
- *Opisthorchis tenuicollis* (Rudolphi).
- *Pseudamphistomum truncatum* (Rudolphi).

Leptonychotes weddellii:
- *Ogmogaster plicatus* (Creplin).

Lobodon carcinophaga:
- *Ogmogaster plicatus* (Creplin).

Family ODOBENIDAE

Mirounga angustirostris (syn. *Macrorhinus angustirostris*):
- *Cryptocotyle lingua* (Creplin).

Odobenus rosmarus:
- *Odhneriella rossica* Skrjabin.
- *Orthosplanchnus fraterculus* Odhner.

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ABBREVIATIONS USED ON PLATES

ac. Acetabulum.
c. Cirrus.
c. p. Cirrus pouch.
es. Esophagus.
exp. Excretory pore.
g. p. Genital pore.
int. Intestine.
lc. Laurer's canal.
lv. Lymph vessels.
mg. Mehlis's gland.
oc. Oral canal.
os. Oral sucker.
ov. Ovary.
ph. Pharynx.
ppr. Pars prostatica.
sr. Seminal receptacle.
sv. Seminal vesicle.
t. Testes.
ut. Uterus.
vd. Vitelline duct.
vit. Vitellaria.
vr. Vitelline reservoir.

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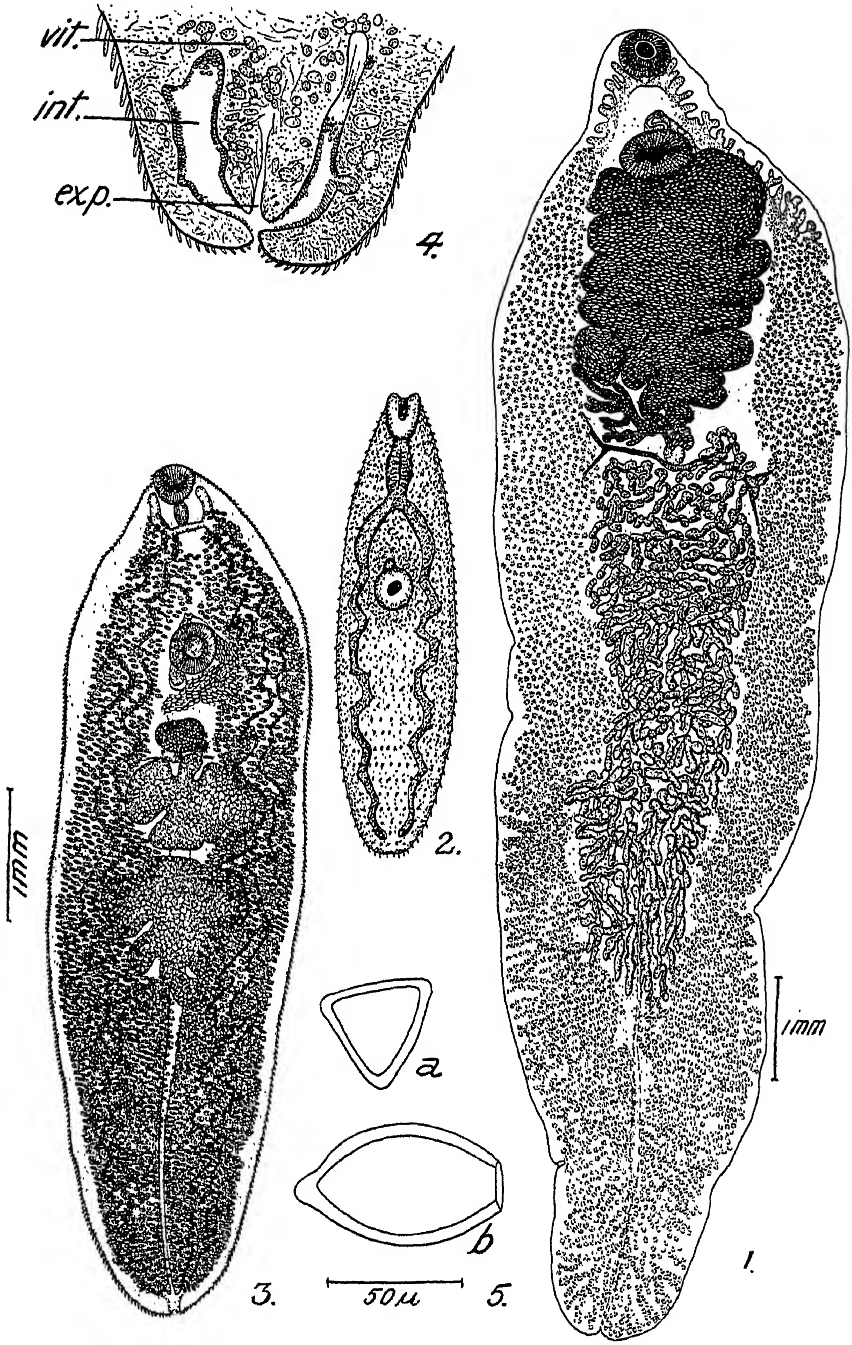
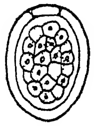


1. *Fasciola hepatica:* From *Orcinus orca*. Original.

2–5. *Campula oblonga:* 2, After Cobbold, 1858; 3, original; 4, section through posterior end of body showing openings of intestinal ceca, original; 5, egg: (a) Cross section, (b) lateral view, original.



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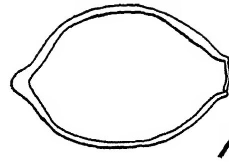

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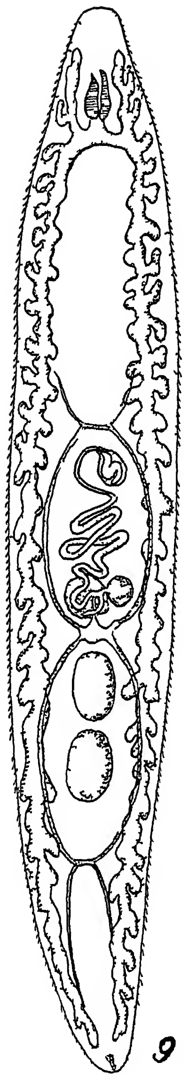

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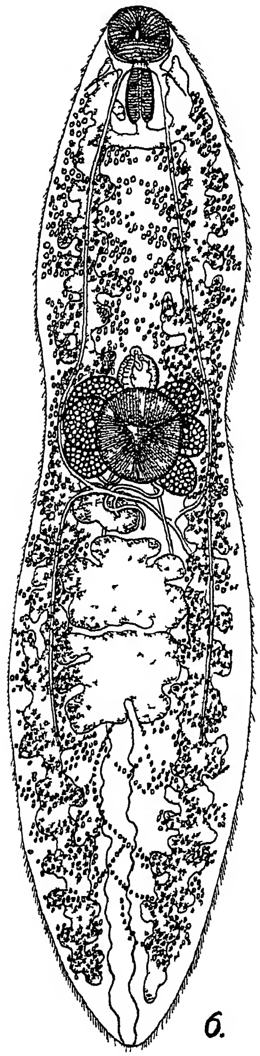

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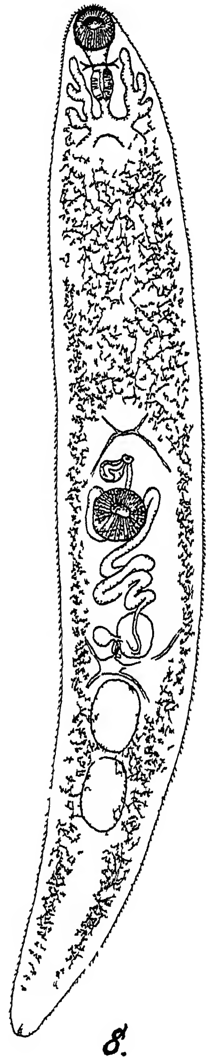
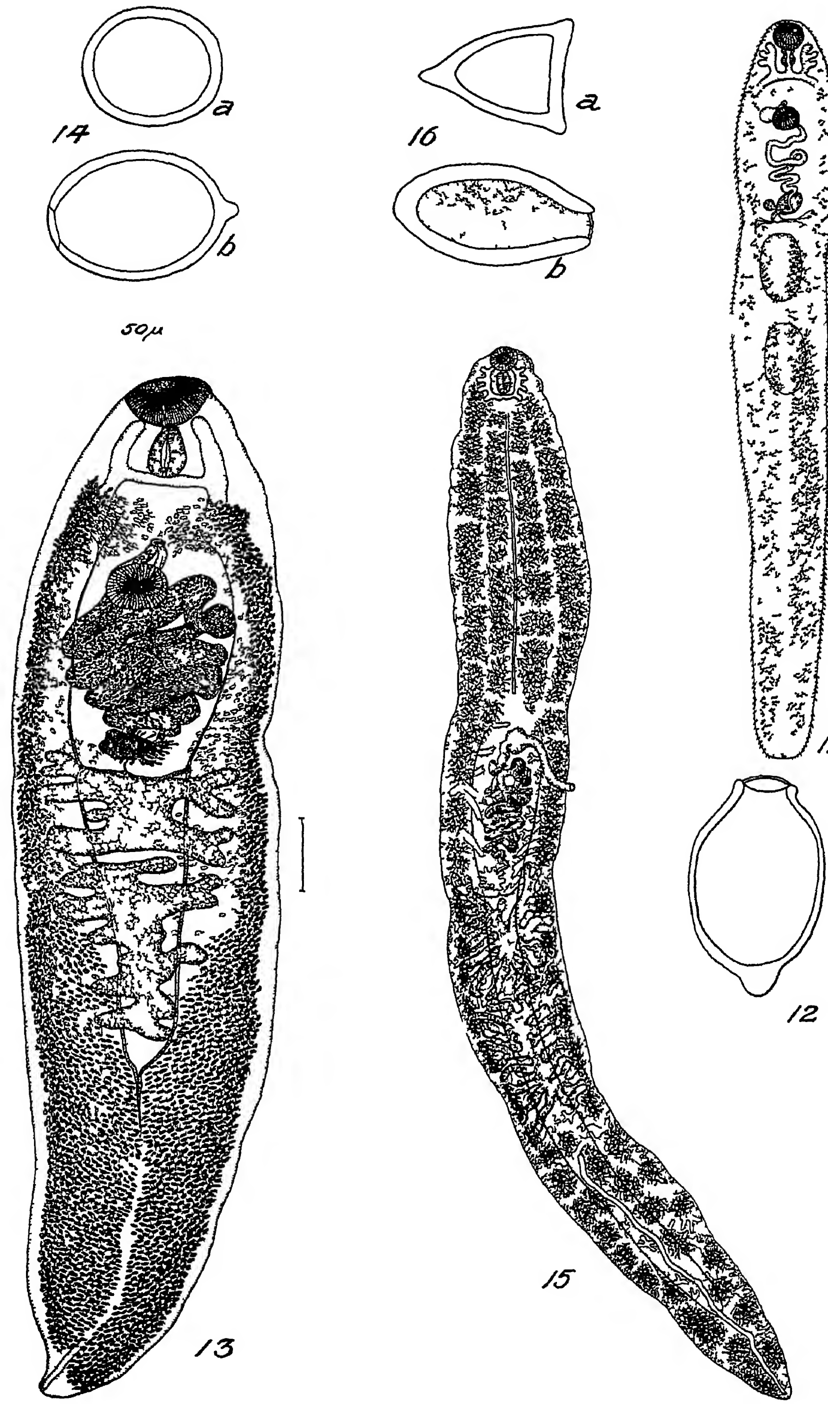
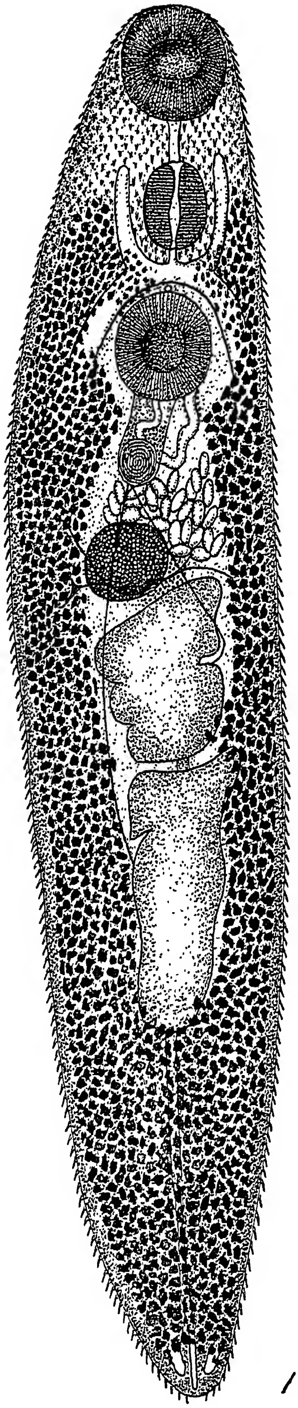


8.

6, 7 *Campula palliata* 6 After Looss 1885 7 egg after Looss 1885
8–10 *C delphini* 8 Ventral view after Poirier 1886 9 dorsal view showing digestive system and arrangement of vitelline ducts after Poirier 1886 10 egg after Poirier 1886



11, 12, *Campula rochebruni*. 11, After Poirier 1886. 12, egg, after Poirier 1886.
13, 14, *Zalophotrema hepaticum*. 13, Original. 14, egg: (a) Cross section; (b) lateral view; original.
15, 16, *Lecithodesmus goliath*. 15, After Odhner 1905. 16, egg: (a) Cross section; (b) lateral view; after Odhner 1905.



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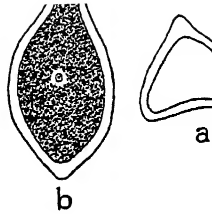

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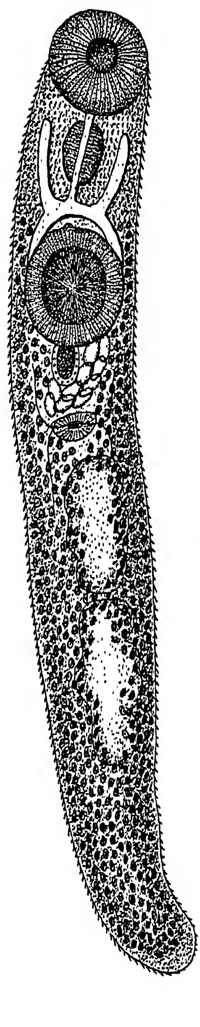
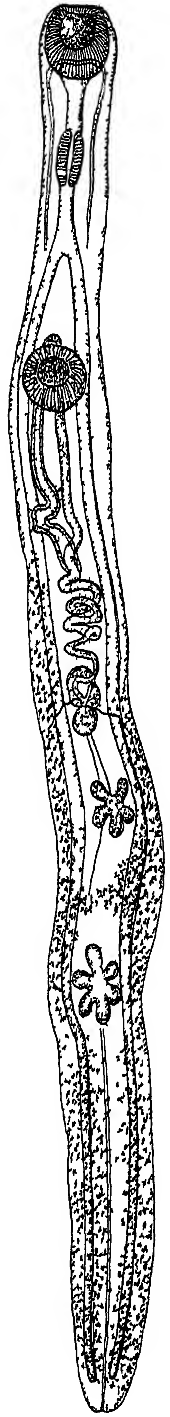
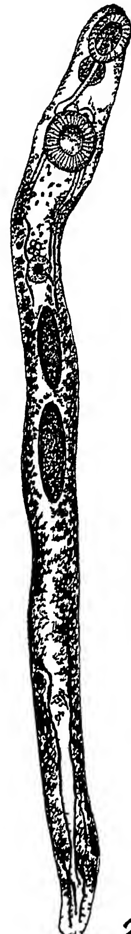


19.

17, 18. *Orthosplanchnus arcticus:* 17, After Odhner, 1905; 18, egg: (a) Cross section, (b) lateral view, after Odhner, 1905.
19. *O. fraterculus:* After Odhner, 1905.





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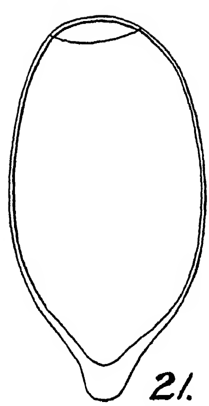
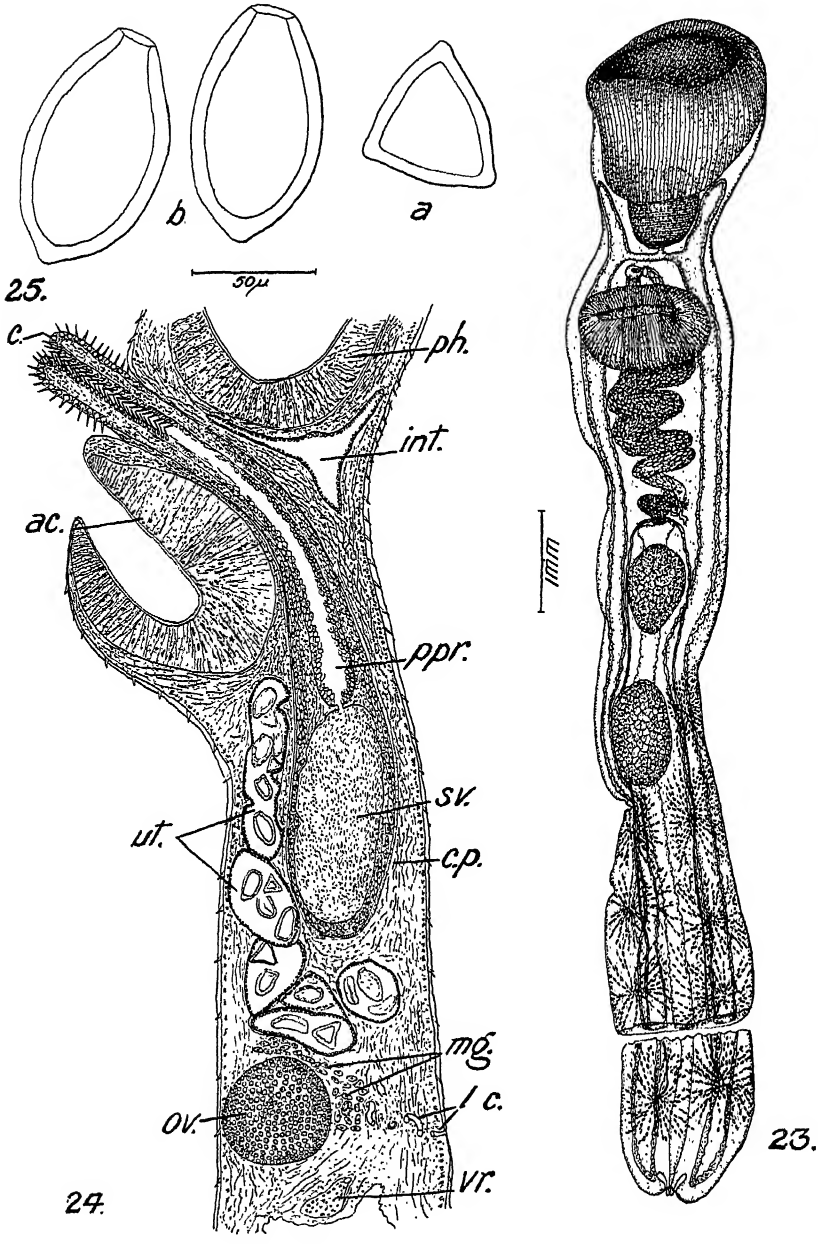


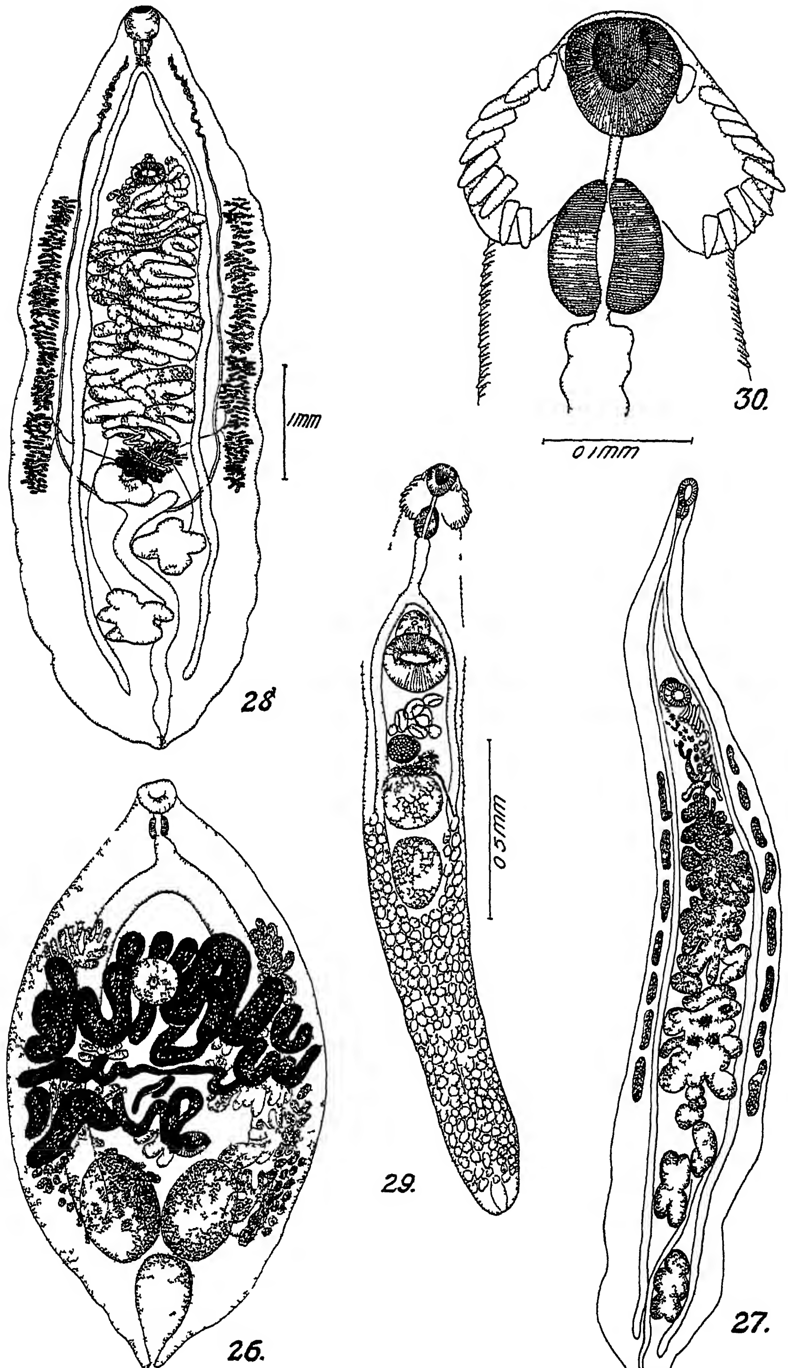
21.

20, 21 *Synthesium tursionis* 20 After Poirier 1886 21 egg after Poirier 1886
22 *Odhneriella rossica* After Skrjabin 1915

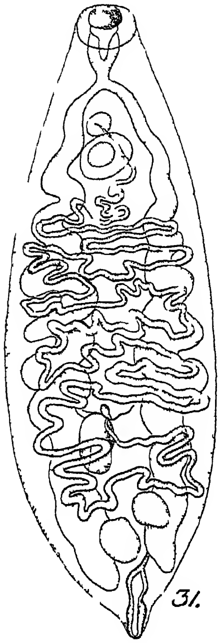


HADWENIUS SEYMOURI, NEW GENUS, NEW SPECIES

23, Original; 24, sagittal section through male copulatory organs, original; 25, egg: (a) Cross section, (b) lateral view, original.



26 *Pholeter gastrophilus* After Kossack 1910
27, 28 *Opisthorchis tenuicollis* After Braun 1893 28 from *Halichoerus grypus* original
29, 30 *Stephanoprora denticulata* 29 From *Zalophus californianus* original 30 anterior end original



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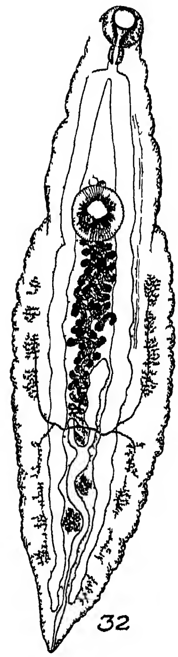

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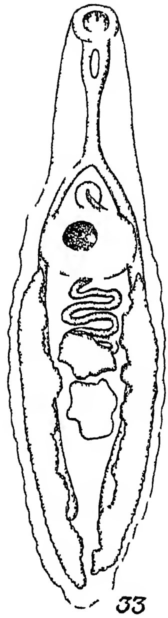

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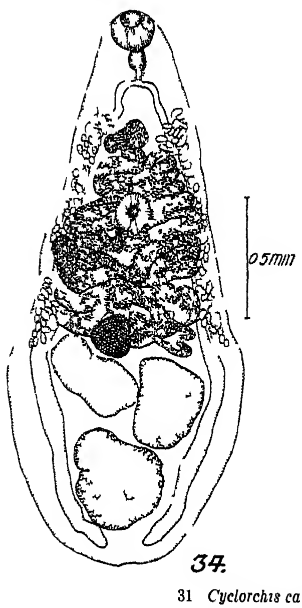

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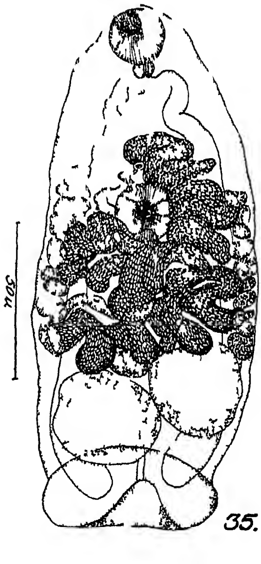
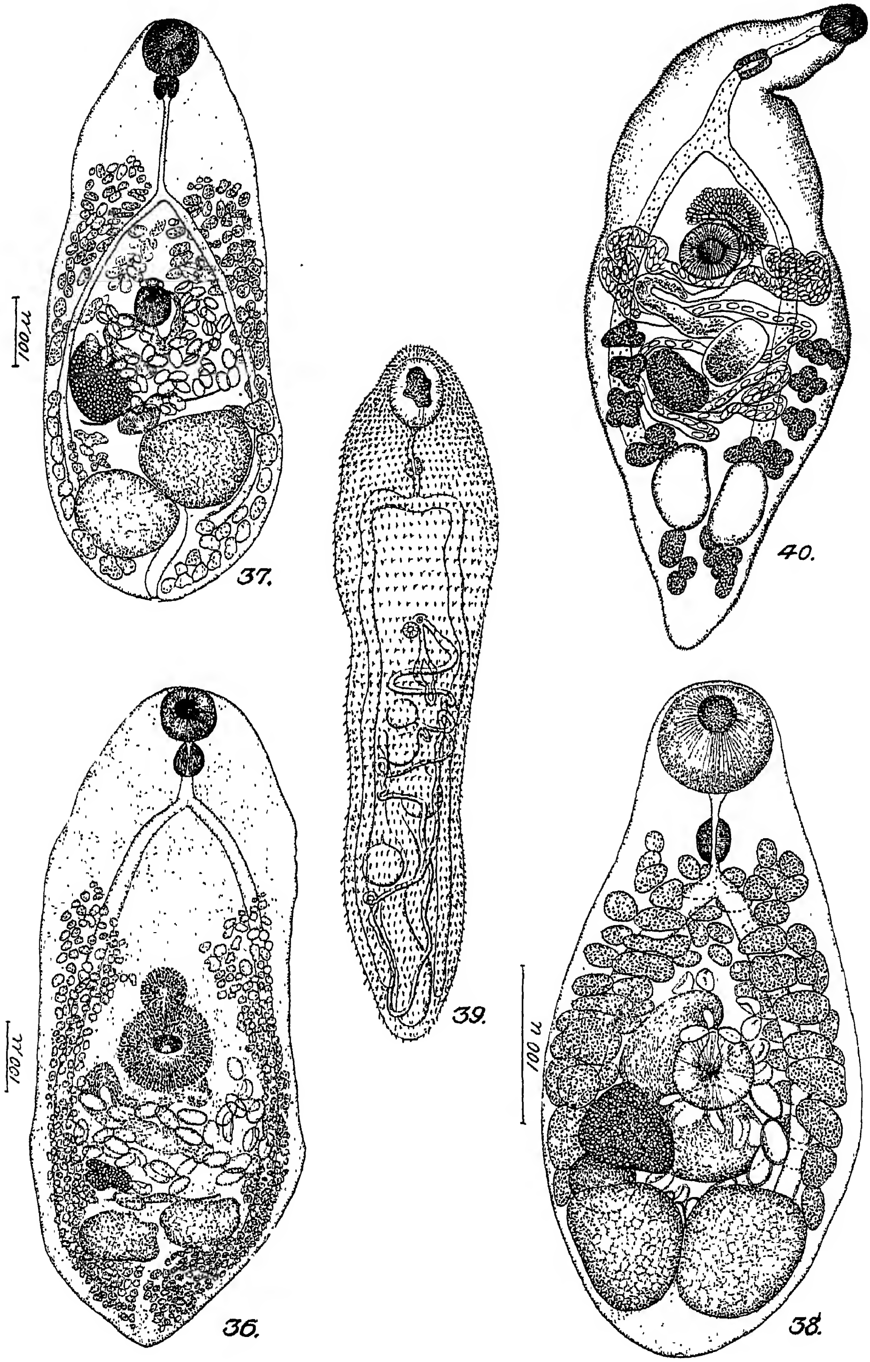
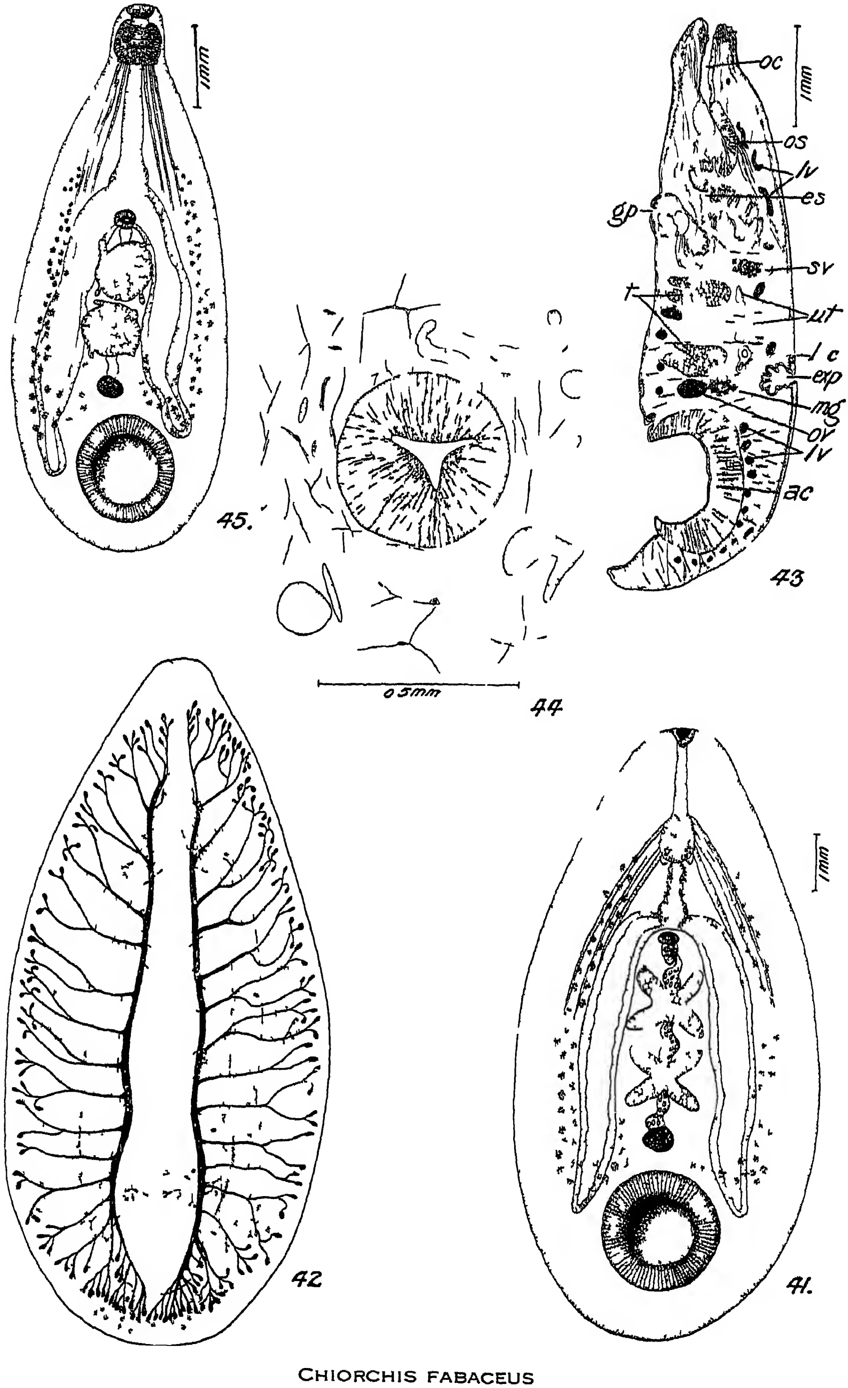


35.

31 *Cyclorchis campula* After Cobbold 1879
32 *Amphimerus lancea* After Weski 1900
33 ? *Amphimerus lancea* After Cobbold 1879
34 *Metorchis albidus* From dog original
35 *Pseudamphistomum truncatum* From *Phoca vitulina*

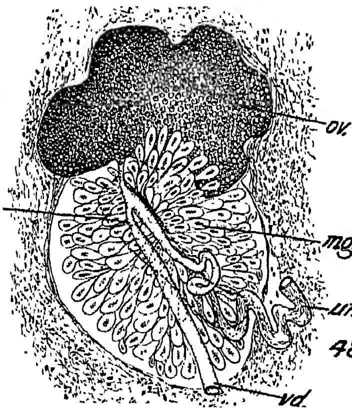


36. *Cryptocotyle lingua:* From *Phoca vitulina*, original.
37. *Apophallus donicus:* From *Phoca vitulina*, original.
38. *A. zalophi:* Original.
39. *Galactosomum erinaceum:* After Poirier, 1886.
40. *Phocitrema fusiforme:* After Goto and Ozaki, 1930.



CHIORCHIS FABACEUS

41 Mature specimen ventral view original 42 lymph system dorsal view original 43 sagittal section original 44 frontal section through genital sucker original 45 immature specimen showing protruded oral sucker original



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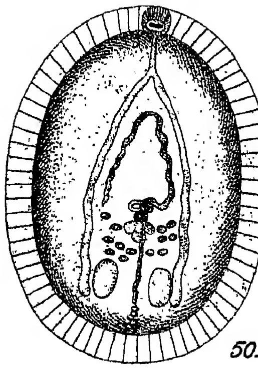

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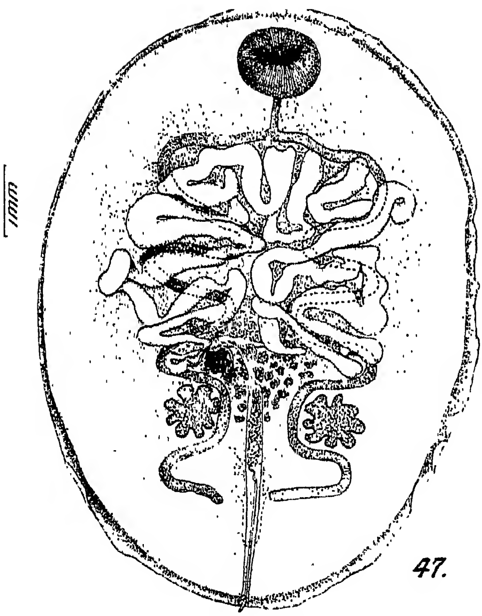

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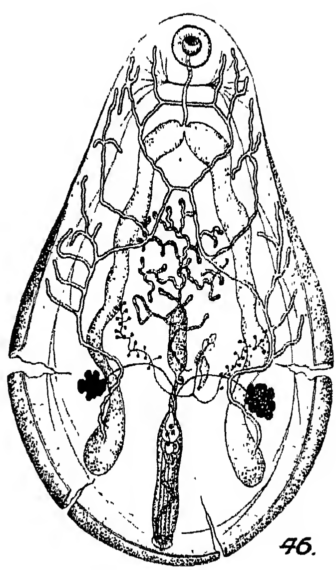
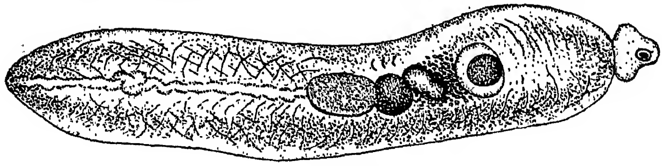


46.

46. *Opisthotrema dujonis:* After Fischer, 1883.

47–49. *O. cochleotrema:* 47, Original; 48, section through female genitalia, original; 49, spines from ventral surface, original.

50. *Pulmonicola pulmonale:* After von Linstow, 1904.



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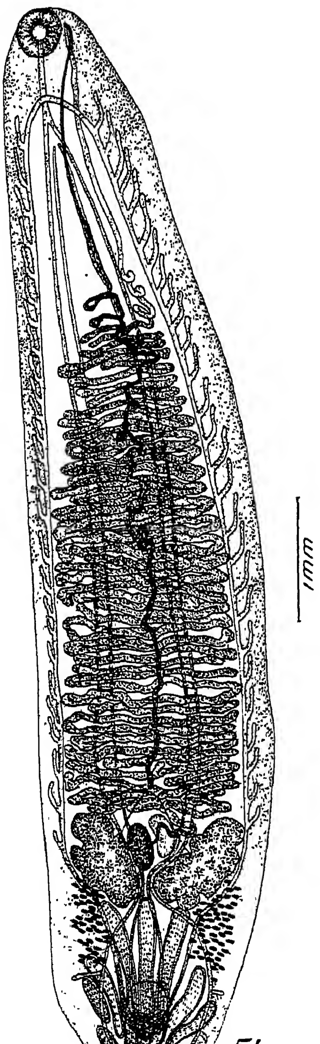

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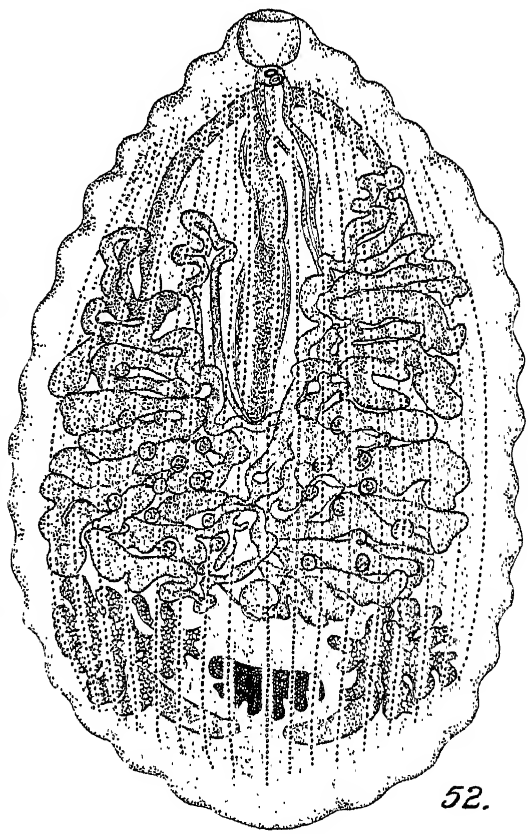
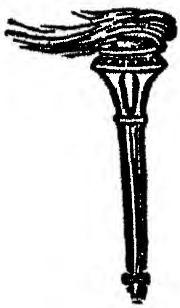


52.

51. *Rhabdiopoeus taylori:* After S. J. Johnston, 1913.
52. *Ogmogaster plicatus:* From *Balaenoptera acutorostrata*. Original.
53. *Distoma andersoni:* After Cobbold, 1879.



TWO NEW LAND SHELLS OF THE GENUS BULIMULUS FROM BOLIVIA

BY

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TWO NEW LAND SHELLS OF THE GENUS BULIMULUS FROM BOLIVIA

By William B. Marshall

Assistant Curator, Division of Mollusks, United States National Museum

Six specimens of land shells from Tamañani, on the Upper Ayapayo River, 85 miles northeast of Oruro, Bolivia, collected in 1930 and presented to the National Museum by Frank L. Hess, of the United States Geological Survey, included the two new species which are described in this paper.

BULIMULUS (SCUTALUS) HESSI, new species

Plate 1, Figures 1, 2, 5, 6

Shell large, stout, rather thick. Spire conoidal, whorls 7, slightly convex, rapidly increasing. Apical whorls finely reticulated with innumerable fine lines. Suture well marked, the summit of each whorl margined by white, strong crenulations. Sculpture of many coarse, slightly retractive growth riblets, the early whorls showing many fine spiral incised lines; on the later whorls the spirals are nearly obsolete, showing only here and there in the spaces between the growth riblets. Body whorl very large. Apex white, next two whorls flesh color, third whorl pale chestnut, next whorl chestnut, body whorl nearly chocolate color, with a faint narrow darker spiral line circling the periphery. Many of the growth riblets whitish. Umbilicus large, but in a front view of the shell concealed by the wide reflection of the columella. Aperture subquadrate, a trifle elongate, its outer lip somewhat thickened and slightly reflected, basal lip more reflected, the columella nearly perpendicular and widely reflected over the open umbilicus. Parietal wall with a thick callus. Edge of peritreme and the parietal callus cream color, a broad band of white just within. Interior livid violaceous.

Type.—The type (U.S.N.M. No. 382217) measures: Length, 56 mm; greatest diameter, 28 mm; height of aperture, 27 mm. It and four paratypes (U.S.N.M. No. 382218) were received from F. L. Hess, for whom the species is named.

Remarks.—Three of the paratypes are almost exactly like the type; the fourth is slenderer, its columella somewhat oblique and twisted. The species is closely related to *Bulimulus* (*Scutalus*) *pluto* Crosse, but is larger, darker, more inflated, its columella nearly perpendicular, much wider, and with no external evidence of a twist. Crosse said, "the two embryonic whorls smooth and polished, whitish." Probably they were worn smooth, but if perfect would be like those of *hessi*. This species and *B.* (*S.*) *pluto* form a natural group quite different from the group of *B.* (*S.*) *tupacii*, and yet, although lacking any indications of granules, evidently related through that species to the subgenus *Scutalus*.

BULIMULUS (SCUTALUS) BOLIVIANUS, new species

PLATE 1, FIGURES 3, 4

Shell slender, very elongate, of rather thin texture, early whorls rapidly increasing in diameter, making the upper end of the spire low conical; middle portion increasing slowly, making that part subcylindrical; body whorl becoming somewhat inflated as it approaches the aperture, making it stand out obliquely from the general contour of the whorls immediately above. Whorls 7, sutures boldly marked, the top of each whorl strongly crenulated. The penultimate whorl after making its first half turn falls below the periphery, giving a distorted appearance, especially to the rear view. Approaching the aperture the body whorl mounts until the suture is at the periphery. (The dropping and mounting of the whorl may be abnormal.) Sculpture consisting of the strong crenulations along the suture, many well-marked, slightly protractive growth riblets, and very faint incised spiral lines. Nuclear whorls worn, but bearing traces of numerous wavy, very fine vertical striae. Color white, with many well-marked spiral bands and some maculations of light chestnut. Aperture oblique, occupying about two-fifths the length of the shell. Peristome slightly thickened within, and a little reflected. Columella nearly straight and vertical, widely reflected, standing separated from the prominent umbilicus but concealing it when viewed from the front. Edge of peristome tinged with yellowish; interior of shell white, the colors of the exterior showing through as bands and spots.

Type.—The type (and only specimen, U.S.N.M. No. 382216) measures: Length, 61 mm; greatest diameter, 27 mm; height of aperture, 27 mm.

Remarks.—So far as known, this is the longest and one of the slenderest *Scutalus*. There seems little doubt that it is properly placed in the subgenus *Scutalus*. The sculpture of its apical whorls, the

white crenulations along the suture, and the oblique aperture all indicate that it is properly allocated to that subgenus, and the upper whorls all show that the young shell was very similar to the young of several other species of the subgenus, especially *Bulimulus* (*Scutalus*) *alauda* Hupé and *B.* (*S.*) *thamnoicus marmorata* d' Orbigny, which surely is a synonym of *B.* (*S.*) *alauda.* It seems possible that the shells described by Hupé and d' Orbigny are immature, and if fully developed would be *B.* (*S.*) *bolivianus.* The thin outer lip indicates young shells, but the reflection of the columella shows that the adult stage is nearly reached. Unlike most species of the subgenus *Scutalus*, this new species shows no traces of granulation, and this serves to distinguish it sharply from *B.* (*S.*) *angrandi* Morelet, which it mimics in form and color.

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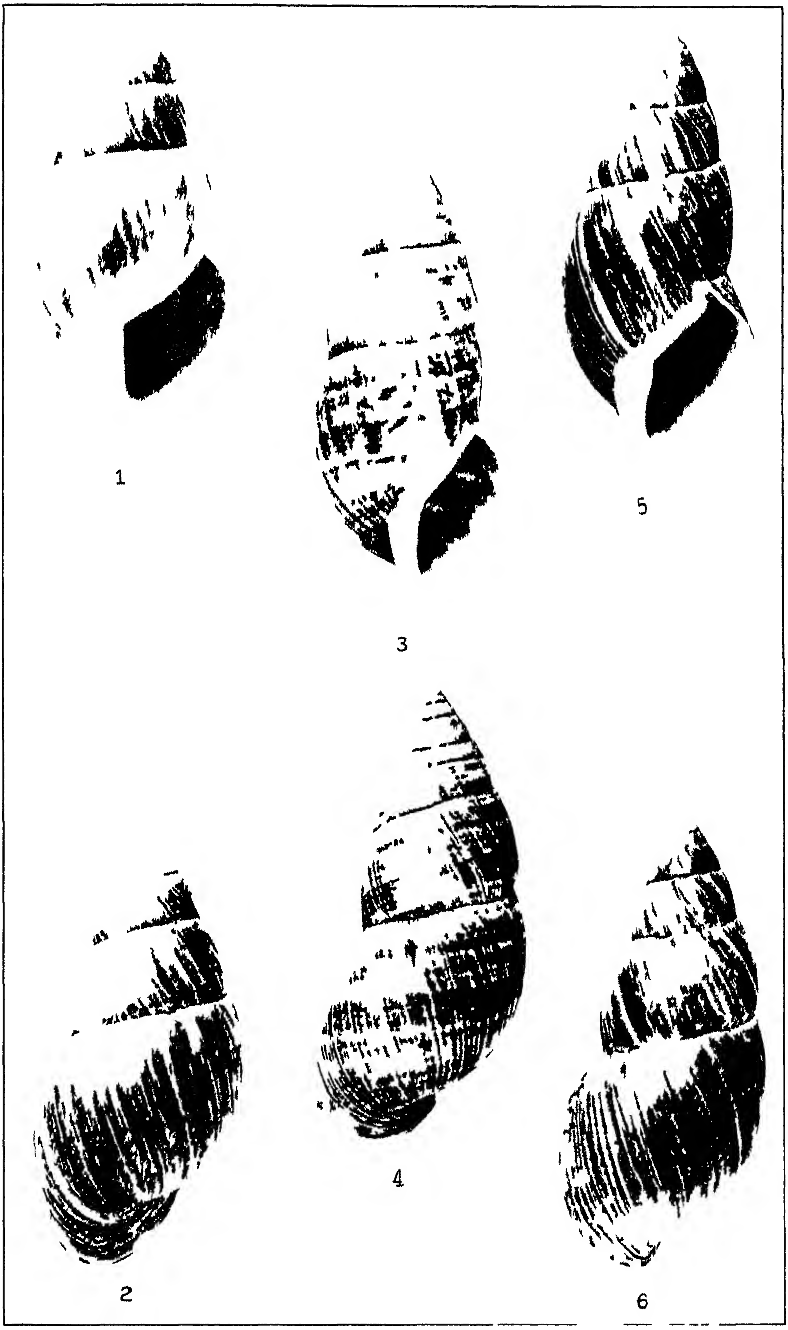

NEW SPECIES OF BULIMULUS FROM BOLIVIA

1, 2. *Bulimulus* (S[illegible]) [illegible], type. 3, 4. *B.* (S.) [illegible]*mani*, type. [illegible] *B.* (S.) [illegible], paratype.

A MIOCENE MOLLUSK OF THE GENUS HALIOTIS FROM THE TEMBLOR RANGE, CALIFORNIA

BY

W. P. WOODRING
United States Geological Survey

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A MIOCENE MOLLUSK OF THE GENUS HALIOTIS FROM THE TEMBLOR RANGE, CALIFORNIA[1]

By W. P. Woodring

United States Geological Survey

Among the many unrecorded lots of California Tertiary fossils in the national collections is one obtained by Robert Anderson and R. W. Pack in 1909 in the hills along the west edge of the southern Temblor Range adjoining Elkhorn Plain, which lies on the northeast side of the San Andreas rift in eastern San Luis Obispo County, Calif. This collection contains 20 specimens of *Haliotis*. Though very little shell substance is preserved, the material is far better than the three imperfect specimens on which *Haliotis palaea*,[2] the first American Miocene species to be described, was based. The relative abundance of a genus so rare in the fossil state made an impression on the collectors—an impression so lasting that Mr. Pack on seeing the account of *Haliotis palaea* recalled their find and wrote to me concerning it.

In the description of *Haliotis palaea* attention was drawn to the rarity of *Haliotis* and of most other rock-clinging shells as fossils. Its relative abundance at the locality discovered by Messrs. Anderson and Pack hardly affords a basis for altering that view. It is estimated that the total number of Miocene shells that have been collected in California runs into the tens of thousands and that the number of localities is in the thousands, yet exactly 23 specimens of *Haliotis* have so far turned up, and they have been found at 2 localities. The other fossils collected at the Temblor Range locality give no clue as to the unusual conditions that favored the rapid burial of the abalone shells, and no observations are available as to the rocky headlands on which they lived.

Genus HALIOTIS Linnaeus

Haliotis Linnaeus, Syst. Nat., ed. 10, p. 779, 1758.

Type (by subsequent designation, Montfort, Conch. Syst., vol. 2, p. 119. 1810).—*Haliotis asininus* Linnaeus (emendation for *asinina*), recent Indo-Pacific.

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[1] Published with the permission of the Director of the U. S. Geological Survey.

[2] Woodring, W. P., A Miocene *Haliotis* from southern California. Journ. Pal., vol. 5, no. 1, pp. 34–39, pl. 6, 1931.

When I commented on Montfort's designation of the least "typical" of the known species as the type species of *Haliotis*, Iredale's[3] remarks on the same subject were overlooked. Iredale considered *asinina* worthy of separate generic rank. If this view is adopted, I would be in favor of appealing for special protection for the name *Haliotis*, as Iredale later intimated is desirable.[4] The ruthless suppression or transferral of familiar names on the grounds of a rigid application of the principle of subsequent designation is very unfortunate.

An unidentified and uncollected *Haliotis* has been recorded from New Zealand beds that are referred to the upper Oligocene.[5] If the age is correctly determined, this is the earliest undoubted *Haliotis* to be recorded.

HALIOTIS LASIA, new species

PLATE 1

Description.—A relatively small, long-ovate, flat *Haliotis* bearing an indeterminate number of open holes (11 to 13 projections are visible on the molds, but some of the earliest represent closed holes). The spire is submarginal. A shallow depression lies along the columellar margin. Above it lies a bulge, which is followed by another shallow depression adjoining the row of holes. Sculpture consisting of slightly undulatory spiral cords of rather uniform width separated by narrow deep grooves. Coarse axial wrinkles are visible on some specimens.

The dimensions of the four largest specimens are as follows:

Length	Width
Millimeters	*Millimeters*
75	51 5 (holotype)
65 5	44 5
49 5	32 8
46	32 3

Type material.—Holotype (U.S.N.M. No. 371767), figured, and 19 paratypes (U.S.N.M. Nos. 371768, 371769), 4 of which are figured.

Type (and only) locality.—Southwest edge of Temblor Range, adjoining Elkhorn Plain, San Luis Obispo County, Calif., NW. ¼ SW. ¼ sec. 6. T. 32 S., R. 22 E., about 200 yards up first western fork of canyon leading toward SW. cor. sec. 6, southwest of 2,800-foot hill between forks, R. Anderson and R. W. Pack, collectors,

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[3] Iredale, Tom, On some misapplied molluscan generic names Proc Malac. Soc. London, vol. 9, p. 260, 1911.

[4] *In* Finlay, H J., A further commentary on New Zealand molluscan systematics, Trans New Zealand Inst, vol 57, p 341, 1926

[5] Powell, A W B, and Bartrum, J A, The Tertiary (Waitematan) molluscan fauna of Oneroa, Waiheke Island Trans New Zealand Inst., vol. 60, p 445, 1929.

June 21, 1909 (U. S. Geol. Survey Loc. No. 12453); Santa Margarita (?) formation, upper Miocene.

Remarks.—The 20 specimens are molds, all of which are more or less imperfect. A few retain traces of shell material. One is a little more convex than others.

The long-ovate outline and submarginal spire suggest that this species belongs in the group of *H. tuberculata* Linnaeus, as defined by Pilsbry,[6] but it closely resembles a small elongate *Haliotis* from San Benito Island off Lower California (U.S.N.M. No. 265600), that has the wide, uniformly spaced, rounded spiral cords and deep narrow grooves of *H. fulgens* Philippi, which belongs in the group of *H. corrugata.* More specimens are needed to determine whether the Lower California *Haliotis* is an elongate form of *fulgens* or whether the similarity of sculpture is attributable to parallelism. The fossils have more uniformly spaced spiral threads and are smaller than *H. walallensis* Stearns,[7] which seems to be a genuine California representative of the *tuberculata* group. In outline and size they resemble the Japanese *H. japonica* Reeve (*tuberculata* group), which lacks the bulge and depression between the columellar margin and the row of holes. Young specimens of the Californian *H. rufescens* Swainson (*corrugata* group) are more elongate than adults, but their surface is undulated by coarse waves, and they have less uniform sculpture and less strongly developed bulge and depression.

The sandstone carrying *Haliotis lasia* was placed in the Santa Margarita formation by the collectors. According to the field notes, it is part of a zone of conglomerate and sandstone, and lies about 200 feet above a bed carrying an echinoid identified by Anderson and Pack as *Astrodapsis antiselli* Conrad, provided the beds are not overturned, though the two sets of beds were not found in a continuous section. W. D. Kleinpell, of Bakersfield, Calif., who is familiar with the geology of the southern Temblor Range, has kindly examined this locality and reports that the beds are not overturned. According to Mr. Kleinpell, in the Salinas Valley *Astrodapsis antiselli* is found above the Santa Margarita formation (upper Miocene) in the lower part of Reed's[8] Poncho Rico formation, which may straddle the Miocene-Pliocene boundary in terms of the California Coast Range section as now accepted. Therefore, the Temblor Range *Haliotis*-bearing bed may be younger than the

[6] Pilsbry, H. A., Man. Conch., vol. 12, pp. 76, 85, 1890.

[7] Stearns, Robert E C, Preliminary description of a new variety of *Haliotis* Nautilus, vol 12, no. 9. pp 106–107, 1899 Description of a new variety of *Haliotis* from California, with faunal and geographical notes. Proc. U. S Nat Mus., vol. 22, pp. 139–142, 1900

Dall, W. H, U S. Nat. Mus. Bull. 112, pl. 22, 1921

[8] Reed, R. D., The post-Monterey disturbance in the Salinas Valley, Calif Journ. Geol., vol. 33, no. 6, pp. 591, 603, 606, 1925

Santa Margarita formation, but it is questionably referred to it and is tentatively considered of late upper Miocene age.

If the stage of evolution as to size and bulging petals attained by *Astrodapsis antiselli* as compared with the small flat-petaled astrodapses collected in the Santa Monica Mountains at the type locality of *Haliotis palaea* means anything, *H. lasia* is considerably younger than *palaea*, though both are referred to the upper Miocene. These two species are not at all similar to each other.

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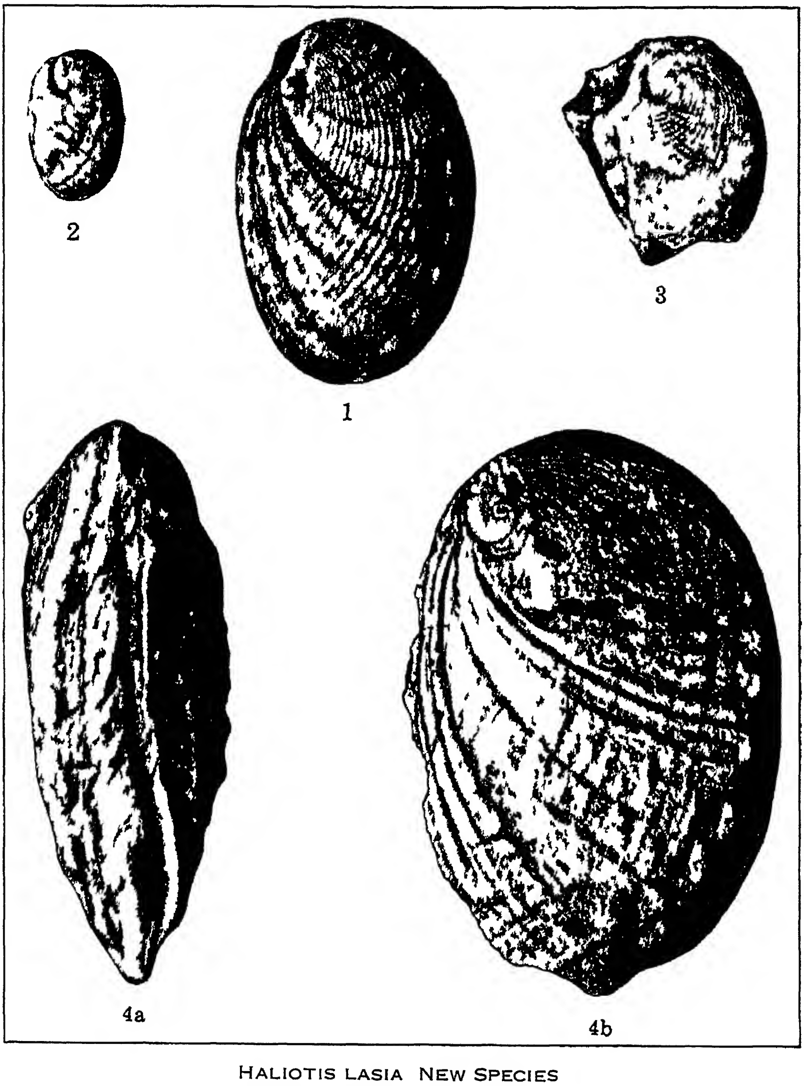

HALIOTIS LASIA, NEW SPECIES

1–3, Paratypes (U. S. N. M. No. 371768). 4a, 4b, holotype (U. S. N. M. No. 371767). All figures natural size and all from Santa Margarita (?) formation, southwest edge of Temblor Range, Calif. U. S. Geological Survey Loc. No. 12453.

THE HELMINTHS PARASITIC IN THE AMPHIBIA AND REPTILIA OF HOUSTON, TEXAS AND VICINITY

BY

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THE HELMINTHS PARASITIC IN THE AMPHIBIA AND REPTILIA OF HOUSTON, TEXAS, AND VICINITY

By Paul D. Harwood

Rice Institute, Houston, Tex.

CONTENTS

INTRODUCTION

Our knowledge of the helminths parasitic in the amphibians and reptiles of North America is still very limited. Leidy, Stafford, Cort, Stunkard, and Walton have made the most important contributions to the scientific study of this group of worms, but many authors have contributed important papers. I was engaged in the collection and study of the parasites of the Reptilia and Amphibia of the Houston, Tex., region, for 2½ years. More than 500 host animals representing 50 species have been examined. All adult parasitic worms, other than leeches, were collected and preserved for study. Usually the encysted forms were neglected, but one interesting cysticercoid is herein described.

There is no universal agreement among helminthologists as to the exact status of many of the major groups that are used in systematic classification. In this paper the classification of the trematodes is based on Faust's Human Helminthology, that of the cestodes on Southwell's Fauna of British India: Cestodes, and that of the nematodes on Baylis and Daubney's A Synopsis of the Families and Genera of Nematoda. The host names employed are those used in Stejneger and Barbour's A Check List of North American Amphibians and Reptiles, second edition.

This work has been done under the direction and criticism of Dr. A. C. Chandler, of the Rice Institute, Houston, Tex., for whose interest and suggestions I wish to express my sincere appreciation. I am further indebted to him for the use of his private library of reprints. Many other acknowledgments are made in various places throughout the paper.

Class TREMATODA

Family POLYSTOMIDAE van Beneden, 1858

Genus POLYSTOMA Zeder, 1800

Worms of this genus have long been known to be parasitic in North American turtles, but Stunkard (1917) has suggested that they are not cogeneric with *Polystoma integerrimum*, the type species of the genus. Ward (1917) erected for them a new subgenus, *Polystomoides*. I have found four species of polystomes belonging to Ward's subgenus, one of which appears to be new.

POLYSTOMA (POLYSTOMOIDES) HASSALLI Goto, 1899

This trematode has been found in the urinary bladder of *Kinosternon subrubrum hippocrepis* and *Chelydra serpentina* in the vicinity of Houston, Tex., and in the former species at Huntsville, Tex.

POLYSTOMA (POLYSTOMOIDES) ORBICULARE Stunkard, 1916

A polystome, which I assign to this species, was found in the bladder of several specimens of *Pseudemys elegans* taken at Houston, Tex. Some of the material exceeds in size the limits given by Stunkard (1917) for *Polystoma orbiculare*, but the relative size of the organs remains constant, and there can be very little doubt that my material is identical with Stunkard's. In respect to size, these larger specimens resemble *Polystoma inerme* and *P. spinulosum* MacCallum (1918b) rather closely, but because my material shows many intermediate types I believe that both species may prove to be synonymous with *P. orbiculare*, as Stunkard (1924) has already suggested.

POLYSTOMA (POLYSTOMOIDES) TERRAPENIS, new species

Plate 1, Figure 1

Specific diagnosis.—Polystoma: Small polystomes of a flattened, ovoid shape. The body length varies from 1.9 to 2.5 mm, and the width varies from 0.72 to 0.82 mm. The caudal disk is circular, from 0.64 to 0.8 mm in diameter, and the six suckers are nearly equally spaced. The suckers are of the usual form, and in the bottom of each there is a small hook. The suckers are 0.18 to 0.2 mm in diameter. Sometimes the larval hooks may be found on the disk, but otherwise there are no hooks present. The larval hooks are about 20μ long. The oral sucker is 0.26 to 0.28 mm long and 0.29 to 0.36 mm wide. It is followed immediately by the pharynx, which is 0.13 to 0.17 mm long and 0.19 to 0.22 mm wide. Even in whole mounts a short esophagus may be distinguished. The in-

testinal ceca extend nearly to the posterior end and are of the usual type. The testis is located in the middle of the body. It is 0.3 to 0.33 mm long by 0.23 to 0.28 mm wide. The vas deferens passes forward on the ovarian side of the body, median and dorsal to the ovary. The terminal portion of the tube is enlarged to form a seminal vesicle. The cirrus sac is 82μ to 90μ in diameter. The genital coronet contains 16 hooks. The ovary is lateral in position, nearly spherical, and 67μ to 85μ in diameter. The ootype is median, ventral, and caudal to the ovary. As usual it receives the two vitello-vaginal ducts. From it the genito-intestinal canal could be seen extending to the intestinal cecum of the ovarian side. A few nuclei around the ootype appear to represent Mehlis's gland. The vitellaria are extensively developed in the lateral fields, but they leave the intercecal space relatively free. The lateral fields converge just posterior to the pharynx and again posterior to the most anterior pair of suckers of the caudal disk. Between these lines the vitellaria extend only slightly beyond the median border of the intestinal ceca. The vaginae open at the lateral margins of the body, on the level of or slightly anterior to the ovary. The sides of the body are sharply indented at this point. The egg is 0.18 to 0.22 mm in diameter. No specific characters were observed in the excretory system.

Host.—*Terrapene carolina triunguis.*

Locality.—Houston, Tex.

Habitat.—Urinary bladder.

Type specimen.—U.S.N.M. Helm. Coll. No. 30864.

Remarks.—This species is very similar to *P. orbiculare* and *P. floridanum*, but it is a smaller worm, and the vitellaria do not crowd into the intercecal area posterior to the testis as they do in *P. orbiculare* and *P. floridanum.* Furthermore, the pharynx and cirrus sac are much smaller in *P. terrapenis.*

POLYSTOMA (POLYSTOMOIDES) MEGACOTYLE Stunkard, 1916

In spite of slight differences from this form as described by Stunkard (1917), I am referring a number of specimens from the mouth of *Pseudemys elegans* to this species. Stunkard's material consisted of three specimens from the mouth of *Chrysemys marginata* from Creston, Iowa. A fourth specimen from the same host Stunkard described as type and sole specimen of another species, *Polystoma microcotyle.* Though the differences between the two forms were distinct they were not very great, and my material shows many intermediate forms.

My material consists of eight adult specimens, and only the length of the great hooks consistently varies from Stunkard's description. The length of the great hooks varies from 140μ to 190μ in my ma-

terial, while Stunkard gives only one measurement, 116μ, for both *P. megacotyle* and *P. microcotyle.* Stunkard lists, as the distinguishing characters between *P. megacotyle* and *P. microcotyle*, the number of hooks in the genital coronet, and the size of the caudal suckers.

For *P. megacotyle* he gives 36 and 42 as the number of hooks in the genital coronet of the two specimens counted. For *P. microcotyle* he gives 32. In my material the number varies from 29 to 37. Stunkard does not give the size of the caudal sucker of *P. megacotyle*, but by measuring the figure we arrive at 0.4 mm as the probable diameter of the caudal suckers. The diameter of the caudal suckers of *P. microcotyle* is given as 0.28 mm. The diameter of the caudal suckers in my material varies from 0.3 to 0.45 mm. The range of variation in my material is so great that specific distinction between *P. megacotyle* and *P. microcotyle* seems unlikely. This seems even more unlikely when Stunkard's limited material is taken into consideration.

Family HERONIMIDAE WARD, 1918

Genus HERONIMUS MacCallum, 1902

This genus is known only from the lungs of North American turtles.

HERONIMUS CHELYDRAE MacCallum, 1902

Since MacCallum described this worm it has been reported from many hosts other than *Chelydra serpentina.* At Houston, Tex., it has been found in the lungs of *Kinosternon subrubrum hippocrepis* and of *Pseudemys elegans.* Only the former host is new.

Family SPIRORCHIDAE Stunkard, 1921

Subfamily SPIRORCHINAE Stunkard, 1921

Genus HENOTOSOMA Stunkard, 1922

This genus was established in 1922 by Stunkard for *Spirorchis chelydrae* MacCallum and *Henotosoma haematobium* Stunkard. MacCallum (1926) rejected it, but neglected to say why. Although undoubtedly closely related to *Spirorchis*, it seems to be worthy of recognition as a distinct genus, with characters as defined by Stunkard (1923).

HENOTOSOMA CHELYDRAE (MacCallum, 1922)

Four specimens of this fluke were taken from the heart of a snapping turtle captured near Houston, Tex. Comparison of my specimens with the descriptions of *H. haematobium* Stunkard and of *H. chelydrae* MacCallum left me in some doubt as to which of the

two my specimens should be referred. Comparison with some specimens of *H. haematobium*, which were kindly supplied by Doctor Stunkard, showed that my forms are not identical with these. They differ in having more closely packed and more deeply lobed testes, which are the characters that Stunkard pointed out as essential differences between his *H. haematobium* and the specimen that was sent to him by MacCallum as representative of *H. chelydrae*. From MacCallum's description it is not possible to differentiate the two species. My specimens are, therefore, referred to *Henotosoma chelydrae*.

Family PARAMPHISTOMATIDAE (Fischoeder, 1901) Stiles and Goldberger, 1910

Subfamily DIPLODISCINAE Cohn, 1904

This subfamily was founded in 1904 by Cohn to include the three genera *Diplodiscus*, *Opisthodiscus*, and *Catadiscus*. The history of the North American members of this group began somewhat previous to that time, for both Stafford and Leidy had reported the presence of *Diplodiscus subclavatus* in North American frogs. Stafford (1905) separated the North American form from the European and named it *Diplodiscus temperatus*. No other representatives of this group were described from North America until Chandler (1923) proposed the genus *Megalodiscus* for a new species that he discovered in the rectum of *Amphiuma means*. Millzner (1924) added *Megalodiscus ranophilus* from the rectum of the common leopard frog to Chandler's genus. Since that time some little doubt has been thrown on the validity of *Megalodiscus*, but no thorough discussion of the problem has been forthcoming. Chapin (1926) believed that *Megalodiscus ranophilus* was identical with *Diplodiscus temperatus*. Cort (1926) agreed with Chapin, and in addition stated his belief that *Megalodiscus* should be considered a synonym of *Diplodiscus*. Hunter (1930) placed *Megalodiscus americanus* in the genus *Diplodiscus*. On the other hand, Holl (1928a) expresses himself as follows: "The writer has not seen any specimens of *Megalodiscus*, but believes that future work will show that there are a number of species, belonging to this group, in North America." Poche (1926) listed *Megalodiscus* with the Diplodiscinae. Fukui (1929) rejected *Megalodiscus*, stating that the differences cited are not of generic value. He included *Diplodiscus temperatus*, however, with those forms having a single testis in contrast to those having two, and thereby confused the whole group. Neither in my own material nor in any available descriptions have I found any reference to *D. temperatus* having any tendency whatsoever toward fusion of the testes.

The foregoing account briefly indicates the uncertainty and disagreement that exist among investigators concerning the validity of *Megalodiscus.* A comparison of *Megalodiscus americanus* with other North American forms shows a striking resemblance. Thus *Diplodiscus temperatus* possesses the small sucker in the center of the acetabulum, although it is very inconspicuous in many adult specimens. The acetabulum, although relatively a smaller structure than in *Megalodiscus americanus*, is, nevertheless, as wide as or wider than the body. The testes are conspicuously smaller. In other respects the differences are very minor, and as the differences already pointed out are of specific rather than of generic value, there can be little doubt that these two forms are cogeneric. I agree with Chapin (1926) that *Megalodiscus ranophilus* Millzner is synonymous with *Diplodiscus temperatus* Stafford. *Diplodiscus intermedius* Hunter seems to be a valid species, in many respects intermediate between the above-mentioned forms.

Holl (1928a) has described a new species of this group from *Triturus viridescens.* Apparently the basis for including his form in the genus *Opisthodiscus* is the presence of a small sucker in the center of the acetabulum and the absence of black concretions in the excretory system. I have already shown that the first character is common to other North American forms of this group, while in my collection there exist examples of *Diplodiscus temperatus* with conspicuous granules in the excretory ducts, while other specimens lack these. On the other hand, Holl's description of *Opisthodiscus americanus* shows some important differences from *O. diplodiscoides*, the type species of *Opisthodiscus.* The type species lacks an esophageal bulb, the oral sucker and pharyngeal pockets are relatively extremely large, the intestinal ceca are asymmetrical, and the ovary is median and between the testes. Holl's species has none of these characters but is, on the other hand, similar to the other North American forms of the group that have been placed in the genera *Diplodiscus* and *Megalodiscus.* It therefore becomes necessary to transfer Holl's species to one of these two genera. Indeed, on comparing some specimens of *Opisthodiscus americanus*, which Doctor Holl kindly sent me, with some barely mature examples of *Diplodiscus temperatus*, which were taken from local frogs, I find it impossible to separate the two forms, and I therefore consider Holl's species to be identical with *Diplodiscus temperatus.*

It appears, from what has been said above, that all the American species of this group [*temperatus* Stafford (including *ranophilus* Millzner and *americanus* Holl), *americanus* Chandler, and *intermedius* Hunter] are cogeneric. If, however, these species be com-

pared with *Diplodiscus subclavatus*, the type species of *Diplodiscus*, important differences appear. In *D. subclavatus* the testes are single except in very young specimens; the vitellaria extend in two groups from the pharyngeal region to the caudal end of the intestinal ceca; and the posterior sucker has a cavity in its center instead of a prominence with special musculature. In the North American forms there is never any indication of fusion of the testes; the vitellaria are arranged in two or four compact groups with the anterior follicles scarcely reaching the level of the anterior testis; and the posterior sucker has a prominence with special musculature. These seem to me to be rather fundamental differences and to justify the placing of the North American forms in a separate genus. The name *Megalodiscus* Chandler (1923), proposed for his species *americanus*, is available for these North American forms. *Diplodiscus temperatus* Stafford and *D. intermedius* Hunter become *Megalodiscus temperatus* (Stafford) and *M. intermedius* (Hunter), respectively. *Megalodiscus americanus* stands as the type species of the genus. *Opisthodiscus americanus* Holl and *Megalodiscus ranophilus* Millzner fall into synonymy with *M. temperatus.*

Genus MEGALODISCUS Chandler, 1923

MEGALODISCUS AMERICANUS Chandler, 1923

A single specimen taken from the rectum of *Rana sphenocephala* is tentatively referred to this species. The testes are relatively somewhat larger than any of Chandler's specimens of *M. americanus*, and they overlap more. These are minor differences, and in view of the limited material and wide host ranges known to exist among amphistomes, there seems to be no justification for its separation into a new species.

MEGALODISCUS TEMPERATUS (Stafford, 1905)

Stafford described this species from frogs. It is widely distributed in these animals in eastern North America. I have taken it from *Rana sphenocephala*, *R. catesbeiana*, *R. areolata*, *R. clamitans*, and *Pseudacris triseriata*, at Houston, and from the first two hosts mentioned and *Hyla cinerea* at Huntsville, Tex.

The above account, besides adding to our locality records, includes four new hosts.

The material from the various hosts presented such a variety of appearances that I at first thought a number of species were present, but on careful examination it was impossible to find any constant character by which to separate any new species. The five specimens from *Pseudacris triseriata* were barely 1 mm long, yet eggs were

present in the uterus of one specimen. These small specimens, however proved to be *Megalodiscus temperatus*, by comparison with young individuals from other hosts.

Family DICROCOELIIDAE Looss, 1907

Genus MESOCOELIUM Odhner, 1911

This genus is known by many species from Asia, Africa, and Australia, but so far as I am aware there is no previous record from America.

MESOCOELIUM AMERICANUM, new species

PLATE 1, FIGURE 2

Specific diagnosis.—Mesocoelium: Body length 1.2 to 2 mm, maximum width 0.5 to 0.7 mm. When properly relaxed before fixing and not flattened, the body is widest in the region of the intestinal fork, rounds anteriorly, and tapers gradually posteriorly. The cuticula is thin, and in the cephalic region it contains numerous short spines. The oral sucker is subterminal and nearly circular in outline. The diameter varies from 0.21 to 0.27 mm. The acetabulum in young specimens lies at the end of the first third of the body, but because of the distention of the posterior region with eggs it is relatively more cephalad in the older specimens. It is 0.13 to 0.2 mm in diameter. The ratio between the acetabulum and the oral sucker varies somewhat, but usually falls between 3:5 and 3:4. The prepharynx is very short and in whole mounts is often obscured. The pharynx is nearly globular and measures 63μ to 105μ in diameter. It is very close to one-half the diameter of the acetabulum. The esophagus is short, seldom equaling the diameter of the pharynx. The ceca curve sharply laterad, then turn caudal and run parallel to the lateral margins. In young specimens they nearly reach the middle of the body, but in fully matured specimens they do not extend far beyond the end of the first third of the body. The genital organs lie close in the fork of the intestine. The ovary is posterior to the testes on the left side, and its cephalic margin nearly always lies anterior to the posterior margin of the acetabulum. It is somewhat irregular in shape but is usually more or less ovoid, with the tip directed medio-caudad. It varies from 0.084 to 0.092 mm to 0.14 by 0.18 mm. The ootype and Mehlis's gland lie medio-caudad of the ovary. On the caudal margin of these structures there is a small yolk reservoir; at this point a seminal receptacle empties and Laurer's canal leaves. The seminal receptacle is a simple sac lying posterior to the yolk reservoir. Laurer's canal runs medio-caudad, loops back on itself,

and finally opens on the median, dorsal surface at the level of the yolk reservoir. The extensive coils of the uterus fill the body posterior to the genital field and to some extent invade the genital field itself. In unflattened specimens they usually obscure the ootype and Mehlis's gland and often extend laterad beyond the ceca. The eggs measure 20–31μ by 38–44μ. The vitellaria reach cephalad to the middle of the oral sucker and caudad to the ends of the ceca. They only slightly overlap the ceca and are mostly lateral to them. In the esophageal region the vitellarian fields widen considerably. The testes lie anterior to the ovary, but only slightly so. The testis of the ovarian side is the more anterior of the two. They are somewhat irregular in shape, apparently because of pressure from the intestinal ceca, the acetabulum, and the female genital system. They are of approximately equal size and vary from 0.07 by 0.105 mm to 0.14 by 0.15 mm. The vasa efferentia leave from the medio-cephalic corners and extend to the seminal vesicle in the cirrus sac. The cirrus sac is about 0.15 mm long and runs caudad from the genital pore, which is median and lies in the region of the intestinal fork. A pars prostatica is present. The simple capillary excretory vesicle extends from the terminal excretory pore to a point slightly behind the seminal receptacle.

Hosts.—*Storeria dekayi*, *Leiolopisma laterale*, and *Eumeces fasciatus*.

Habitat.—Intestine.

Locality.—Houston, Tex.

Type specimens.—U.S.N.M. Helm. Coll. No. 30868; paratype, No. 30869.

Remarks.—This species is very similar to *Mesocoelium microon* Nicoll (1914a) from Australian anurans. The chief difference is that the esophagus is never longer than the pharynx in the present species, while it is twice as long in the Australian form. The testes are smaller relative to the acetabulum, and the ovary appears to be slightly more anterior relative to this organ. The suckers, pharynx, and eggs seem to be a little larger in my species than in Nicoll's.

The record for *Eumeces fasciatus* is based on a single individual, which is so young that there is no indication of either eggs or vitellaria. The ovaries and testes, however, are well developed and occupy the same position relative to each other and to the acetabulum. The ratios between pharynx, acetabulum, and oral sucker are identical with those for the mature specimens of *Mesocoelium americanum*. In the specimen from *Eumeces fasciatus*, however, the acetabulum is relatively farther posterior, being near the middle of the body, and the intestinal ceca are distinctly longer when compared with the length of the body.

Family BRACHYCOELIIDAE S. J. Johnston, 1912

Genus BRACHYCOELIUM Dujardin, 1845

This genus is known in North America by two species from the vermilion-spotted newt, and one species from a North American snake, which died in a London zoo. The following adds three more species.

BRACHYCOELIUM HOSPITALE Stafford, 1900

This fluke was described by Stafford (1900) from Canadian salamanders. I refer to it some specimens taken from *Rana sphenocephala*. Stafford's (1903) later description is for the most part adequate, but my material shows a few variations that need to be mentioned. Stafford gives the ratio of the oral sucker to the acetabulum as 4:3. In my material this ratio varies from 3:2 to 4:3. The eggs in fully matured individuals fall very close to the dimensions given by Stafford, but in young individuals they are very variable in size.

BRACHYCOELIUM STORERIAE, new species

PLATE 1, FIGURE 3

Specific diagnosis.—Brachycoelium: Body length 1.19 mm, width 0.25 mm. The cuticula is thin, and very fine spines are imbedded in it in the region of the oral sucker, but these disappear before the middle of the body is reached. The oral sucker is subterminal and measures 140μ in diameter. The acetabulum measures 84μ by 100μ. The ratio of oral sucker to acetabulum, therefore, approximates 3:2. The anterior margin of the acetabulum is 0.42 mm from the anterior end. It, therefore, lies entirely caudal of the posterior limit of the first third of the body. A very short prepharynx leads to the oval pharynx, which measures 38μ by 46μ. The esophagus is rather long, measuring about 0.126 mm. At its posterior end lie the two short, divergent ceca, which just reach the acetabulum. The ovary lies on the right side of the body at the level of the acetabulum. It is a nearly spherical structure, 70μ in diameter. The rest of the ovarian complex could not be made out with certainty, but it is believed that the ootype and Mehlis's gland lie median and dorsal to the ovary. A structure that appears to be a seminal receptacle lies median to the cephalic margin of the ovary. The exact course of the uterus can not be traced. The eggs lie in the posterior portions of the body, behind the ovary but to some extent overlying the testes. Apparently the uterus passes around the left side of the acetabulum to the median genital pore. The genital pore lies just anterior to the acetabulum. The vitellaria are extensively developed. They extend from a line, the width of the pharynx behind that structure, to the level of the testes. They are within the dorsal portions of the body and occupy

the median as well as the lateral fields. The eggs are oval, measuring 50μ by 34μ. The testes are not quite symmetrically placed, the right one being slightly caudal to its mate; they measure about 80μ by 47μ. They are slightly obscured by the eggs ventrad and the vitellaria dorsad. The vasa efferentia could not be traced, but a seminal vesicle appears in the cirrus pouch. The cirrus pouch is a V-shaped structure, with the ventral arm the longer and more distended. It runs cephalo-laterad for a short distance, then loops back in a medio-caudal direction. It ends dorsal to the center of the acetabulum. The excretory system could not be seen.

Host.—*Storeria dekayi.*

Habitat.—Intestine.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30873.

Remarks.—This species is easily distinguished from other known species of *Brachycoelium* by the distribution of the vitellaria. Also the acetabulum is more posterior than in most species, but this is a poor character because of the distention of the posterior end by the egg mass in fully matured individuals.

BRACHYCOELIUM sp.

A single poorly prepared specimen taken from the intestine of *Opheodrys aestivus* is referred to this genus. This is the same host from which Nicoll (1914a) described *Brachycoelium obesum*, but the distribution of the vitellaria is somewhat different from that figured by Nicoll, and consequently it is impossible to refer it to his species.

BRACHYCOELIUM MERIDIONALIS, new species

PLATE 1, FIGURE 4

Specific diagnosis.—*Brachycoelium:* A small oval worm, colorless except where the eggs show through. Length 0.8 mm to 0.95 mm, width 0.3 mm to 0.4 mm. The cuticula is thickly studded with small spines in the cephalic regions, but these become sparser caudad. The oral sucker is subterminal and measures about 0.145 mm in diameter. The acetabulum lies near the caudal boundary of the first third of the body and has a diameter varying from 0.125 mm to 0.138 mm. The ratio of the oral sucker to the acetabulum is very close to as 3 : 2. The pharynx is an oval with the long diameter lying transversely. It measures 38μ by 50μ. The esophagus is about twice as long as the pharynx. In fully matured individuals these two structures are often wholly concealed by the transverse band of vitellaria. The intestinal ceca are short pockets, measuring 85μ by 130μ. The testes are 105μ to 115μ in diameter and are slightly irregular in outline. They lie one on each side of the body, their cephalic margins near the

level of the caudal boundary of the acetabulum, but the testis on the ovarian side is slightly posterior to its mate. The genital pore is slightly cephalic to the acetabulum. The cirrus sac, which contains the seminal receptacle, usually resembles the shape of an inverted comma and usually lies partially beneath the acetabulum. The ovary is nearly globular, is lateral in position, and lies at the level of the acetabulum. It measures 76μ to 84μ in diameter. Mehlis's gland lies medio-caudal to the ovary. The vitellaria lie between the middle of the esophagus and the caudal end of the intestinal ceca. Two yolk ducts become visible at the caudo-lateral limits of the vitellarian follicles and extend in a curve from this point to a small yolk reservoir, dorsal to Mehlis's gland. The vitellaria extend from the caudal margin of the oral sucker to the caudal extremities of the intestinal ceca but not beyond. In the dorsal portions of the worm they extend in a continuous band from side to side. The uterus fills the body caudal to the testes. The eggs measure 29μ by 42μ.

Host.—*Triturus meridionalis.*

Habitat.—Upper intestine.

Locality.—Houston, Tex.

Type specimens.—U.S.N.M. Helm. Coll. No. 30874; paratype, No. 30875.

Remarks.—The host, *T. meridionalis*, is so closely related to *T. viridescens* that for some time it was considered to be a variety of the latter. A species of *Brachycoelium*—*B. hospitale* Stafford—has already been described from *T. viridescens* in Canada. A form of *Brachycoelium*, which seems to be identical with *B. hospitale*, has been found several times in specimens of *Rana sphenocephala* captured locally, but oddly enough it was not found in *T. meridionalis.* The situation is further complicated by Holl's species *B. trituri*, from the eastern form of the newt. Doctor Holl kindly loaned me two specimens of *B. trituri* from his private collection. A comparison of this material resulted in the following observations:

B. meridionalis differs from *B. hospitale* and *B. trituri* by having a continuous bridge of vitellarian follicles from one side to the other. It further differs from *B. hospitale* by having larger intestinal ceca, and the vitellaria do not extend so far caudad.

BRACHYCOELIUM DAVIESI, new species [1]

PLATE 1, FIGURE 5

Specific diagnosis.—*Brachycoelium:* The worms vary from 0.65 to 0.95 mm in length and from 0.3 to 0.55 mm in width. Those whose

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[1] I take pleasure in naming this trematode after J. I. Davies, of the Rice Institute, in recognition of the friendly interest he has taken in this work and of the assistance he has given, particularly in matters involving technique.

measurements are equal to the smaller dimensions given are barely mature and have only a few eggs in the uterus. The body when relaxed is proportionately wider than is the case with other species of *Brachycoelium*. Usually it is about twice as long as wide. The cuticula is thin and set with small spines in the cephalic region. These disappear about the level of the genital glands. The oral sucker is subterminal and nearly circular in outline. Its diameter varies from 0.13 to 0 23 mm. It is about twice the size of the acetabulum. In the type specimen the oral sucker is 0.23 mm and the acetabulum 0.125 mm in diameter. This in my experience represents the extreme variation from the mean of 2:1. The acetabulum has its cephalic margin 0.32 to 0.42 mm from the anterior end and, therefore, is wholly behind the caudal limits of the cephalic third of the body. The prepharynx is lacking, and the oval pharynx measures 42μ to 50μ by 60μ to 65μ, with the long diameter lying transversely. The esophagus is short, being about 30μ long. From its caudal extremity the intestinal ceca extend almost directly laterad. They are largely obscured by the vitellaria. The ovary is lateral, but it may lie on either side. It is usually nearly circular in outline and very variable in size, being relatively larger in younger specimens. It averages 100μ in diameter. The ootype and Mehlis's gland can not be seen in whole mounts, but in sections they plainly show on the latero-dorsal side of the ovary. The seminal receptacle could not be located. The uterus fills the body behind the ovary, partially if not wholly obscuring the testes and Mehlis's gland. The eggs are 29μ to 31μ by 40μ to 42μ. The vitellaria are well developed. They fill the lateral fields from the ovary to the oral sucker, and a band of follicles extends across the body between the oral sucker and the genital pore. As the digestive system is included in this region these follicles make observations on this system difficult in whole mounts. In the median field, they are confined to the dorsal half of the body, but laterad they lie both dorsal and ventral to all other organs. The testes are level with the acetabulum and posterior to the ovary. The testis on the ovarian side is closely pressed against the ovary but is, nevertheless, slightly caudal to its mate. The vasa efferentia could not be traced. The genital pore lies at the cephalic margin of the acetabulum. The cirrus sac, containing a seminal vesicle, runs first cephalad and then curves laterad away from the ovary, and its distal end lies at the level of the genital pore. The excretory vesicle is quite concealed by the uterus in whole mounts, but in sections it shows as a characteristic simple sac extending to the caudal limits of the testes.

Hosts.—*Leiolopisma laterale*, *Pseudacris triseriata*, *Hyla cinerea*, and *Ambystoma microstomum*. As the parasites from the last two hosts mentioned are both immature, these two records must be regarded as tentative.

Habitat.—Intestine, more frequently in the anterior half.

Localities.—Houston and Huntsville, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30876; additional specimen, No. 30877.

Remarks.—*Brachycoelium daviesi* differs from most other species of *Brachycoelium* in many ways. The body when relaxed is proportionately wider, the esophagus is shorter, and the ovary is cephalic to the acetabulum. It is distinguished from all but *B. trituri* by the ratio of the acetabulum to the oral sucker, and from all but *B. storeriae* and *B. meridionalis* by the presence of a transverse bridge of vitellarian follicles between the lateral fields.

Genus GLYPTHELMINS Stafford, 1905

Miller (1930) has carefully redescribed the type species of this genus, *G. quieta*, and partially revised the genus. He has shown that *Margeana* Cort (1919) is a synonym of *Glypthelmins*. Since Cort had already placed *Margeana* in the same group with *Brachycoelium*, I refer *Glypthelmins* to the Brachycoeliidae. The following species is the third of this genus to be described from North American frogs:

GLYPTHELMINS SUBTROPICA, new species

PLATE 1, FIGURE 6

Specific diagnosis.—*Glypthelmins*: The body is 1.43 to 2.65 mm long and 0.44 to 0.92 mm wide. The cuticula is covered with small spines except at the extreme anterior end and a part of the posterior end. The oral sucker varies from 0.16 by 0.18 mm to 0.32 by 0.34 mm, and the acetabulum varies from 0.1 to 0.16 mm in diameter. The ratio of the oral sucker to the acetabulum approximates as 5:3 in young specimens, but in fully mature specimens it is nearer as 1:2. The distance from the cephalic margin of the acetabulum to the anterior end is 0.59 to 0.92 mm. The oral sucker is closely followed by a large muscular pharynx. This structure is always a little larger than the acetabulum and varies from 0.12 by 0.15 mm to 0.19 by 0.27 mm. The esophagus is rather short, usually about the length of the pharynx or slightly longer. The ends of the intestinal ceca are removed from the extreme caudal end by a distance of about 0.15 to 0.3 mm. On each side a group of glands extends

from the middle of the pharynx to the level of the intestinal fork. The ovary lies above the right margin of the acetabulum. It is a globular structure 0.3 to 0.6 mm in diameter. It is followed closely by a small ootype and Mehlis's gland. Lateral to the caudal margin of these structures lies a seminal receptaculum about half the size of the ovary. Laurer's canal leaves the female genital system at the point where it is joined by the transverse vitelline ducts and, after a short cephalic course, turns abruptly dorsad to open above the acetabulum. The vitellaria occupy two lateral fields from slightly caudal to the intestinal fork to a point the length of the testes caudal to those structures. Posterior to the acetabulum they extend mesad to the inner margin of the ceca, but anterior to it they extend entirely across the worm. The uterus passes posteriorly in transverse loops, ventral to the testes, and between the intestinal ceca. Caudal to the ceca they spread out the entire width of the body. The ascending loops follow the same course to the level of the ovary, where the uterus passes to the left of the acetabulum and terminates in a metraterm 50μ long. The eggs vary from 33μ by 17μ to 46μ by 25μ. The testes are symmetrically placed and a little more than their diameter behind the ovary. They are globular or oval structures and measure 0.3 by 0.5 mm or more. The vas efferens of the right side passes cephalad, ventral to the seminal receptaculum and ootype, but bends sharply mesad behind the ovary. It meets its fellow and enters the cirrus sac. The vas efferens of the opposite side follows much the same course. The cirrus sac, which contains a seminal vesicle, is an elongate structure curving from the genital pore to the right of the acetabulum and terminating at the caudal border of the ovary. The genital pore is located about halfway between the acetabulum and the intestinal fork. The excretory pore lies at the extreme caudal tip of the body. The vesicle extends forward and forks at the posterior margin of the testes, and the two arms extend forward to the level of the genital pore. The anterior arms are relatively small.

Hosts.—*Rana catesbeiana*, *R. sphenocephala.*

Habitat.—Intestine.

Localities.—Houston and Huntsville, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30878.

Remarks.—This distome most closely resembles *Glypthelmins quieta*, but it may readily be distinguished from this form by the transverse band of vitellaria, the location of the testes behind the transverse vitelline duct, and the tendency of the uterus to pass ventral to the testes rather than between them.

Family PLAGIORCHIIDAE Lühe, 1901

Subfamily PLAGIORCHIINAE Pratt, 1902

Genus HAEMATOLOECHUS Looss, 1899

Synonym: *Pneumonoeces* Looss, 1902.

Concerning the status of these two names, *Haematoloechus* Looss and *Pneumonoeces* Looss, Cort (1915) writes as follows:

> In 1902 on account of Stäl's hemipteran genus *Haematoloecha* established in 1874 Looss (1902: 732) changed the generic name *Haematoloechus* to *Pneumonoeces*. He did this influenced by Braun's (1901: 55) contention that if family or subfamily names are formed from generic names which differed only in endings, they would be identical. This seems to me to be a logical application of the rule of priority and I shall accept the later name *Pneumonoeces*.

Cort's opinion in this matter is not illogical, but unfortunately the International Code of Zoological Nomenclature specifically states that a generic name is not to be considered preoccupied when it differs only in ending from a genus already published. As examples, the genera *Picus* and *Pica* are cited. Therefore, the earlier name *Haematoloechus* must be used. Since this paper was first submitted for publication, the same conclusion has been reached independently by Ingles (1932). It is unfortunate that this change is necessary, since the name *Pneumonoeces* has been in common use for nearly 30 years.

Cort (1915) adequately summarizes our knowledge of this group in North America previous to that date. Since then Irwin (1929) has added one more species, *H. parviplexus*, and two more are described below.

HAEMATOLOECHUS FLOEDAE, new species

PLATE 1, FIGURE 7

Specific diagnosis.—Haematoloechus: Flukes of medium size; the body is elongate, flattened, pointed toward the anterior end but rounded behind. The largest specimen in my possession is 10 mm long; the average, however, are about half that long. The smallest specimen measures 4.4 mm and seems to be fully mature. The width varies from 1.2 to 1.6 mm. The cuticula is smooth and entirely without spines. It is extremely thin, never being more than 4μ in thickness. The large oral sucker measures 3.6 to 4.4 mm in diameter. The ratio between the oral sucker and the pharynx is nearly as 1:2, but the pharynx is often a little smaller; however, the ratio does not fall below as 2:5. The ratio of the oral sucker to the acetabulum falls very close to as 1:3. The acetabulum is only slightly anterior to the middle of the body. In a worm measuring 5.4 mm long the acetabulum is 2.4 mm from the anterior end.

The esophagus in properly expanded specimens is somewhat longer than the pharynx. The wide ceca extend to the posterior end of the body. The ovary lies beside the acetabulum and is irregularly lobed. It is 0.65 to 0.83 mm in length and 0.32 to 0.45 mm in width. The vitellarian follicles are arranged in 19 to 24 groups of irregular size and shape. It is difficult to count the individual follicles in each group, but they seem to range from 1 to 2 dozens. The uterus is arranged much like that of *Haematoloechus parviplexus* Irwin. There are a few loops at the anterior end of the ovary, then the uterus turns caudad, passes between the testes, and after a series of loops in the posterior end of the body there are the usual longitudinal folds outside the intestinal ceca, and then the uterus follows the same route cephalad to the genital pore in the pharyngeal region. There is a little difference in the lengths of the longitudinal folds in my material. They may extend only to the cephalic border of the posterior testis or to the cephalic border of the anterior testis. Not infrequently the uterine fold on the ovarian side of the body is somewhat shorter than its mate. The eggs vary from 21μ by 17μ to 17μ by 13μ. The testes are oval elongate bodies, somewhat irregular in outline. Not infrequently they are pointed at the anterior end. The two overlap for half their length. The posterior testis is usually slightly larger. It measures 0.8 to 1.2 mm in length and 0.34 to 0.7 mm in width. The anterior testis is 0.7 to 1.1 mm in length, and 0.32 to 0.65 mm in width. The size of the testes shows but very little correlation with the size of the worm. The distance of the posterior testis from the posterior end varies too much to be of any use as a character. The seminal vesicle is a large oval sac lying beside the ovary. The genital field is approximately two-fifths of the length of the body, but here again the variation is so great that the character must be of very doubtful use. In a worm 5.5 mm long the genital field measured but 1.8 mm, while in a worm 5.25 mm long the genital field measures 2.2 mm.

Hosts.—*Rana catesbeiana* and *R. clamitans.*

Habitat.—Lung.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30879.

Remarks.—This species most closely resembles *Haematoloechus parviplexus* Irwin, but it may be distinguished from that form by the smaller pharynx, the larger acetabulum, the smooth cuticula, the smaller egg, and the longer longitudinal folds of the uterus. *H. breviplexus* also has a smooth cuticula, but in this species it is exceptionally thick, whereas in *H. floedae* it is very thin. The present species also differs from *H. breviplexus* in size, relatively smaller acetabulum, and the unlobed testes.

HAEMATOLOECHUS UNIPLEXUS, new species

PLATE 2, FIGURE 1

Specific diagnosis.—Haematoloechus: The body is an elongated oval, slightly pointed at the anterior end. It measures 4.25 by 0.7 mm. The cuticula is smooth and without spines. The oral sucker is 0.22 mm in diameter. Its ratio to the pharynx is as 2:3, and its ratio to the acetabulum is close to as 1:3. The pharynx is 0.14 mm in diameter, and the acetabulum is 0.08 mm in diameter. The length of the esophagus is equal to about two-thirds the diameter of the pharynx. From it the intestinal ceca extend to the posterior end of the body. The ovary lies beside the acetabulum. It is an elongate, irregularly lobed structure with its long axis parallel to the long axis of the body. The uterus, after a few folds just anterior to the ovary, turns toward the posterior end. It follows the usual course with the usual confusion of loops and windings to the posterior end of the body. The longitudinal folds outside of the intestinal ceca are very poorly developed. There is a short loop on the left side of the body extending only to the caudal margin of the posterior testis. There is no loop of the uterus on the right side of the body. From the posterior end of the body, the uterus follows the usual course forward to the genital pore, which lies in the pharyngeal region. The vitellarian follicles are so closely grouped that it is very difficult to form an accurate opinion of the number of follicles to the group. There seem to be 9 or 10 follicles to the group and about 21 groups. On the left side of the body the follicles cease at the level of the cephalic margin of the caudal testis. On the right side there are three groups of follicles, below this point. The eggs vary from 21μ by 17μ to 17μ by 13μ. The testes are elongate bodies, with entire margins that overlap slightly. The anterior testis measures 0.5 by 0.16 mm and the posterior one 0.48 by 0.16 mm. The caudal testis is somewhat more than its own length from the caudal tip of the body. The seminal vesicle lies beside the ovary. The length of the genital field, exclusive of the vitellaria, equals slightly more than one-third of the total body length.

Host.—Rana sphenocephala.

Locality.—Houston, Tex.

Habitat.—Lung.

Type specimen.—U.S.N.M. Helm. Coll. No. 30880.

Remarks.—This form closely resembles *Haematoloechus floedae* described above, but it is easily distinguished from that form by the short longitudinal uterine loop, of which there is only one, its unsymmetrical character, the ratio between the oral sucker and the acetabulum, and the position of the testes relative to each other.

The foregoing description of *Haematoloechus uniplexus* is based on a single specimen. No more examples were found, although more than a score examples of the host were examined. Because of the limited material and the great variation known to exist among species of *Haematoloechus*, this form must be regarded as a species inquirenda until more material becomes available. It is possible that it is an example of *Haematoloechus floedae* that is somewhat stunted and malformed by residence in an unsuitable host, but this seems hardly likely.

Subfamily RENIFERINAE Pratt, 1902

Genus RENIFER Pratt, 1902

Of the species originally included in this genus only the type species, *Renifer ellipticus*, remains. Since that time several species have been described in the genus from North American snakes, but many of them have been removed to other genera. At present the genus includes, besides the type species, the following North American species: *Renifer acetabularis* Crow, *R. kansensis* Crow, *R. ancistrodontis* MacCallum, *R. septicus* MacCallum, *R. ophiboli* MacCallum, and *R. natricis* MacCallum. The unnamed *Renifer* species described by Job (1917) seems to belong to *Lechriorchis.*

RENIFER TEXANUS, new species

PLATE 2, FIGURE 2

Specific diagnosis.—Renifer: Body with parallel sides, rounded at each end, 1.83 to 2.2 mm long by 0.75 to 0.85 mm wide. The cuticula is very thickly beset with spines in the anterior region, but more sparsely so in the posterior region. The oral sucker is subterminal with the mouth directed ventrad. It is 0.27 to 0.35 mm in diameter. No prepharynx is present, and therefore the pharynx lies directly above the caudal margin of the oral sucker. The esophagus is short, about equal to the diameter of the pharynx. The ceca barely reach the testes. The acetabulum lies anterior to the middle of the body. It is a large structure measuring about 0.46 mm in diameter. The testes are large, more or less oval structures, lying a short distance behind the acetabulum. They may be arranged either symmetrically or obliquely. They vary from 0.23 by 0.3 mm to 0.22 by 0.4 mm. The vasa efferentia could not be traced. The cirrus sac, which contains the seminal vesicle, extends diagonally across the body from the left cephalic margin of the acetabulum. The genital pore is situated near the lateral body margin, slightly behind the middle of the oral sucker. The ovary is a globular structure, lying on the left side, dorsal to the caudal half of the acetabulum. It is about 0.2 mm in

diameter. Mehlis's gland and the ootype lie on the midline and slightly caudal to the ovary. Laurer's canal was not located. The uterus is a much coiled structure, running caudad between the testes; after filling the body behind the testes with its coils it returns anteriorly by the same course. It passes dorsal to the center of the acetabulum, loops to the left, and runs parallel and ventral to the cirrus sac throughout the length of that organ. The eggs measure 40μ by 21μ. The vitellaria are lateral and are divided by the acetabulum into two fields on each side. The posterior fields extend from the middle of the testes to the middle of the ovary. The anterior fields extend from the intestinal fork to the level of the tip of the cirrus sac. They usually overlie the ceca, but do not extend median to them.

Host.—*Heterodon contortrix.*

Habitat.—Mouth.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30881.

Remarks.—The foregoing description is based on five specimens of flukes taken from two snakes. *Renifer ellipticus* is recorded from this same host, but the two forms are easily distinguished by the location of the genital pore and the division of the vitellaria.

Renifer texanus seems to be most closely related to *R. acetabularis* Crow, but the cirrus sac in that form does not cross the median line, nor reach the acetabulum, and there is an esophagus present.

RENIFER KANSENSIS Crow, 1913

Renifer kansensis Crow and *R. ancistrodontis* MacCallum are both described from specimens taken from the mouth of copperhead snakes (*Agkistrodon mokasen*). *R. ancistrodontis* is described as having the genital pore on the right side, while in *R. kansensis* it is described on the left side. Since helminthologists seem to be rather careless about considering the inverting power of the microscope, this character may be due to an error. Other differences between Crow's and MacCallum's species are: The location of the testes, the ratio of the oral sucker to the acetabulum, the position of the caudal end of the cirrus sac, and the location of the genital pore. With the exception of the last-named difference the variation in my material is practically as great as the differences noted. Crow (1913) describes the genital pore as being on the left side, at the level of the posterior margin of the pharynx; MacCallum (1921) as being on the right side, in advance of the intestinal fork. In my material the genital pore is on the right side, at the level of the pharynx. There seems to be no way of settling this point definitely without the specimens; therefore, I refer my material, which was found in the mouth of *Agkistrodon mokasen* and *Sistrurus miliarius*, to *R. kansensis* and regard *R. ancistrodontis* as a species inquirenda.

RENIFER ANIARUM (Leidy, 1890)

PLATE 2, FIGURE 3

Leidy (1890) described this parasite under the name of *Distomum aniarum*, but since that time the form seems to have been ignored by helminthologists. Leidy's description, while in many points very inadequate from the standpoint of modern taxonomy, is, nevertheless, sufficiently detailed to leave little doubt as to the specific identity of his parasites and of my material from the same host. Since Leidy's description is so brief, the species is redescribed as follows:

Specific diagnosis.—Renifer: Small worms with their sides parallel, rounded at both ends or pointed at the posterior end, length 2.25 to 3.5 mm, width 0.7 to 1.1 mm. The cuticula is well armed with spines in the anterior regions, but posteriorly the spines are weak and scattered. The oral sucker is subterminal and circular in outline, and the mouth opening points cephalo-ventrad. The diameter varies from 0.3 to 0.42 mm. The acetabulum lies close to the center of the body and has a diameter of 0.46 to 0.66 mm. It is, therefore, about one and one-half times the diameter of the oral sucker. A short prepharynx is followed by a globular or oval pharynx 0.13 to 0.16 mm in diameter. The length of the esophagus equals about twice the diameter of the pharynx. The intestinal diverticulae reach to the testes. The testes are oval or circular in outline, and the margins may be slightly irregular. They are usually symmetrically placed, but they may be oblique. They measure from 0.16 by 0.2 mm to 0.38 by 0.36 mm. The vasa efferentia may either join as they enter the cirrus sac or enter separately. The cirrus sac, which contains the seminal vesicle and pars prostatica, extends from a point, slightly to the left of the median line and posterior to the intestinal fork, diagonally across the body to the genital pore, which lies on the right side at the level of the oral sucker. The ovary is a globular structure, which lies on the left side, posterior to the acetabulum but anterior to the testes. Its diameter varies from 0.145 to 0.18 mm. The ootype and Mehlis's gland lie median and usually slightly caudal to the ovary. A short oviduct may or may not be discernible in whole mounts. A small yolk reservoir is present, but the spermatozoa are stored in the ovarian end of the uterus. The uterus, with many loops and coils, descends between the testes, nearly to the caudal end, returns by the same course to the caudal end of the cirrus sac, where the loops cease, and runs parallel and caudal to the cirrus sac to the general pore. The eggs vary from 32μ by 20μ to 42μ by 25μ. The vitellaria are divided into two groups by the acetabulum. The anterior groups extend from the pharynx to points a little caudal of the cephalic margin of the acetabulum. They

usually overlap the intestinal ceca to some extent. The posterior groups begin a little cephalic to the ovary and extend to the testes. They are fairly compact and usually lie outside the intestinal ceca.

Hosts.—*Natrix sipedon* and *N. sipedon fasciata.*

Habitat.—Mouth.

Locality.—Philadelphia, Pa., and Houston, Tex.

Specimens.—U.S.N.M. Helm. Coll. Nos. 30885 and 30886.

Remarks.—This form is apparently very similar to *Renifer natricis* MacCallum, from the mouth of *Natrix taxispilota.* The description of this species is in many ways misleading. The name is not stated to be new, and in the first paragraph of the description MacCallum seems to confuse this worm with certain species of trematodes that are known only from birds and are usually referred to the genus *Prosthogonimus.* MacCallum states that *Renifer natricis* possesses a seminal reservoir, but as this is not known in any other species of *Renifer* it seems doubtful. Differences that seem to justify the separation of MacCallum's form from Leidy's are the distribution of the anterior groups of vitellaria, the presence of a prepharynx, a relatively larger acetabulum, and the position of the genital pore on the opposite side of the body.

Genus LECHRIORCHIS Stafford, 1905

Sumwalt (1926) has reviewed the status of this genus, and she has carefully pointed out the discrepancies and possible errors of past authors. Because of differences in the intestinal ceca and in the location of the genital pore, she has suggested that the genus be divided.

LECHRIORCHIS VALIDUS Nicoll, 1911

Several specimens that I have collected from the lungs and mouths of the hog-nosed snake [*Heterodon contortrix* (=*H. platyrhinus*)] and the king snake (*Lampropeltis getulus holbrooki*) are referred to the above species. These specimens differ in some particulars from Nicoll's description of the types, but in my opinion the differences admit of other explanations than the erection of a new species. Nicoll states that the esophagus is three-fourths the length of the pharynx, while in my material the esophagus, though variable in length, is always longer than the pharynx. In one of Nicoll's figures of *L. validus*, however, the esophagus is distinctly the longer. In all other particulars my specimens agree exactly with Nicoll's description, and therefore I refer them to his species. Manter (1927) has reported this species from the body cavity of the blue racer (*Coluber constrictor flaviventris*).

Genus DASYMETRA Nicoll, 1911

DASYMETRA CONFERTA Nicoll, 1911

I have a total of 26 specimens of this fluke taken from the mouth of two specimens of *Natrix sipedon fasciata* at Houston, Tex. This genus was established in 1911 to receive a single species described at that time from the mouth of *Natrix rhombifera.*

There are two points in which my material shows slight differences from Nicoll's description. Nicoll (1911, p. 684) writes as follows:

> The cirrus pouch is short and stout; in some cases almost globular. * * * As already mentioned, the latter (cirrus) was exserted in every case, so that the arrangement depicted in Figure 8 (Pl. XXVIII) must be regarded as hypothetical.

In my material there are specimens with both exserted and withdrawn cirrus. In the former condition the cirrus pouch is quite as Nicoll has described it, but in the latter condition it is considerably more elongate. In a typical case it is an elongated sac curving to the left of the acetabulum and just reaching the caudal border of that structure. In the caudal end of the cirrus sac is a coiled seminal vesicle, of the usual type for this group. The pharynx is not globular but oval, with the long axis located transversely. Its anterior margin is typically lobate. It measures on the average 0.24 by 0.38 mm.

Genus MANODISTOMUM Stafford, 1905

Stafford founded this genus for a single species, *M. occultum.* The genus is poorly defined and has not been recognized again until Price (1930) pointed out that *Plagitura* Holl (1928) was a synonym of *Manodistomum.* In the following discussion I show that other forms should also be referred to this genus.

MANODISTOMUM OCCULTUM Stafford, 1905

This is the type species of the genus and was reported originally from two hosts, *Diemyctylus viridescens* and *Rana virescens.* The description, however, was based solely on material from the former host. In his discussion of the species, Stafford states that its habitat in the newt was unknown to him, but certain forms, which he had found encapsuled in the muscles of the frog, appeared to be the same, although slightly less mature. My material of this species consists of four specimens, two of which were found in *Triturus viridescens* (=*Diemyctylus viridescens*) at Elizabethtown, N. Y., and two from *Triturus meridionalis* at Houston, Tex. In both cases they were in the intestine, and while the Texas specimens, one of which is figured, were barely mature, the New York specimens were fully mature. All

differences noted between the two lots of material could easily be explained on the basis of age differences or individual variation. When these forms were compared with Stafford's description of *M. occultum* and Holl's description of *Plagitura salamandra*, no differences of importance could be noted. It is, therefore, probable that *Plagitura salamandra* Holl, 1928, should fall as a synonym of *Manodistomum occultum* Stafford, 1905.

At the close of the discussion on *Manodistomum occultum*, Stafford makes the following statement: "The worms bear many resemblances to Nr. 86 from the snake of which, indeed, they may be the young." From my experience (outlined above) it seems probable that *M. occultum* was described from material in its definitive host; but it is only possible at this time to suggest a probable relationship between the type material and the specimens which Stafford found encysted in the frog. "Nr. 86" is described in the same paper as *Zeugorchis aequatus*, a parasite of the garter snake. *Z. aequatus* is poorly described, and while it seems to be specifically distinct from *M. occultum*, I am unable to find valid generic differences. Furthermore, if we examine Sumwalt's excellent description of *Zeugorchis syntomentera*, the only other species referred to the genus *Zeugorchis*, we are still unable to find generic differences. Therefore *Zeugorchis* appears to be a synonym of *Manodistomum*, and it is possible that the encysted forms from the frog are the young of *Z. aequatus*. Accordingly *Zeugorchis aequatus* Stafford, 1905, becomes *Manodistomum aequatum* (Stafford, 1905); *Zeugorchis syntomentera* Sumwalt, 1926, becomes *Manodistomum syntomentera* (Sumwalt, 1926); and *Manodistomum occultum* Stafford, 1905 (=*Plagitura salamandra* Holl, 1928), stands as the genotype.

Genus STOMATREMA Guberlet, 1928

This genus was founded for a single species from the mouth of a snake that had died in the Zoological Gardens of London. As the host had been received from Florida only a fortnight before its death, it is almost certain that the parasites are native to North America.

STOMATREMA PUSILLA Guberlet, 1928

My material consists of 24 specimens taken from the esophagus of *Farancia abacura*, the trophotype for the parasite. There are a few points in which they differ from this form as described by Guberlet (1928), but the general agreement is so close that very little room is left for doubt as to their specific identity. The only important difference is in the seminal receptacle. Guberlet claims that this structure lies between the posterior borders of the testes and empties

by a duct at the point where the ootype enters the uterus. He states that it can not be seen readily in whole mounts as the egg-laden coils of the uterus conceal it. I let some of my specimens remain in tap water until the uterus had been emptied. In these, motile spermatozoa could be plainly seen in the descending portion of the uterus in live specimens, but I was unable to locate any seminal receptacle either in live or in stained material. Two of the flukes were sectioned, but again it was not possible to locate a seminal receptacle. As this structure is lacking in other genera of the Reniferinae, it seems probable that it is lacking in *Stomatrema.* Also, my material is about twice the size of Guberlet's, and in some specimens the vitellaria extend caudad as far as the middle of the ventral sucker. These latter-mentioned differences are of no importance and may be readily explained on the basis of individual variation and different states of contraction.

Family GORGODERIDAE Looss, 1901

Subfamily GORGODERINAE Looss, 1899

Genus GORGODERA Looss, 1899

The bladder flukes of North American frogs were very ably revised by Cort (1912). Since that time only one paper has appeared concerning North American forms.

GORGODERA AMPLICAVA Looss, 1899

I have taken many specimens of *Gorgodera* from the bladder of *Rana catesbeiana* both at Houston and at Huntsville, Tex. Although this fluke is known to have a wide host range, I have been unable to find it in any other local species of frogs. Guberlet (1920) has described *Gorgodera circava* from the bladder of *Rana catesbeiana* in Oklahoma. This fluke differs from *G. amplicava* in ratio of the oral sucker to the acetabulum, the number of vitellarian follicles, the lobation of the ovary, and the possession of an ejaculatory pouch. The number of vitellarian follicles and the lobation of the ovary are in my material very variable characters. Furthermore, the ratio of the oral sucker to the acetabulum in my material covers the entire range reported for both *Gorgodera amplicava* and *G. circava.* The variations, however, showed a strange chronological sequence. In the early part of my collecting I killed my specimens by pouring fixative over them, after the manner recommended by Guberlet. Later I discovered that these flukes could be shaken from the bladder easily if the dish containing them was first thoroughly chilled by exposure to an ice-salt mixture. The degree of cold also completely relaxed the flukes, and they could then be killed with any cold fixa-

tive. The flukes killed by the latter method always possessed acetabula more than 2.5 times larger than the oral sucker, while many of those killed by the former method possessed relatively smaller acetabula. I was unable to distinguish any differences in the male genital system in my material, but as the ejaculatory pouch has not been mentioned in earlier descriptions, it can not be regarded as certainly absent. Therefore, it seems to me that *Gorgodera circava* is a synonym of *G. amplicava*.

Family TELORCHIIDAE Stunkard, 1924

Stunkard included two subfamilies, the Telorchiinae and the Auridistominae, under the family Telorchiidae, but the relationship of the two to each other and to the distomes as a whole is very uncertain. Various authorities have suggested that they are related to the Bunoderidae, the Plagiorchiidae, the Opisthorchiidae, or the Echinostomatoidea. I feel that until more is known concerning the life history of the trematodes included in this group, it will be impossible to settle their phylogenetic relations.

Subfamily TELORCHIINAE Looss, 1899

Genus CERCORCHIS Lühe, 1900

This genus has been treated as a synonym of *Telorchis* by most writers, especially since Stunkard (1916) showed that the characters used by Lühe to separate them were unreliable. Recently Perkins (1929) has shown that the two genera are distinct, and that Lühe's characterization of them had been inadequate. Consequently it becomes necessary to transfer all the North American species of *Telorchis* to *Cercorchis*. These include many species that are parasitic in turtles, and a few that parasitize snakes or amphibians.

CERCORCHIS TEXANUS, new species

Plate 2, Figure 6

Specific diagnosis.—Cercorchis: The fully matured specimens in my material are 6.6 to 8 24 mm long and 0.48 to 0.7 mm wide. The greatest width is usually in the region of the acetabulum. The spines are very thick in the cephalic region, but caudad they become progressively thinner until they quite disappear near the testes. The oral sucker is 0.12 to 0.16 mm in diameter; the acetabulum is the same size and is usually about one-sixth of the body length from the anterior end. The prepharynx is very short, being less than 100μ long. The pharynx is circular; and its diameter is 0.9 to 1.1 mm. The esophagus is moderately long, measuring 0.13 to 0.2 mm

in length. The intestinal ceca extend nearly to the posterior end. The ovary is spherical and lies on the midline or just to the left; it is usually anterior to the middle of the body, but its exact relative location is subject to some little variation. This point will be discussed more fully below. The shell gland and ootype lie immediately behind the ovary; and in favorable specimens Laurer's canal may be seen extending directly to the dorsal wall. The uterus extends posterior on the left side and anterior on the right. The metraterm is straight and measures from 0.67 to 0.8 mm long, or very nearly one-half the distance from the genital pore to the ovary. The vitellaria are arranged in lobes between the intestinal ceca and the lateral margins of the body. The follicles are arranged in groups, with 20 to 40 to the group. The most cephalic extent of the vitellaria is about the level of the caudal end of the metraterm. Their length is to the length of the body as 2:5. They extend about three-fourths of the total distance from ovary to the anterior testis The eggs vary in size from 34μ by 17μ to 34μ by 21μ. The testes are oval and of about equal size. They vary in size from 0.42 by 0.3 to 0.2 by 0.12 mm. The caudal testis is removed from the posterior end by a distance greater than its diameter. The cirrus sac is shorter than the distance from the genital pore to the ovary. It is 1.5 to 1.2 mm long and contains a seminal vesicle that is 0.36 to 0.43 mm long.

Host.—*Pseudemys elegans.*

Habitat.—Intestine.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30889; additional specimen, No. 30890.

Remarks.—The position of the ovary in the body has frequently been used as a criterion for separating different species in the genus *Cercorchis.* A study of my material, which consists of fully mature worms and of barely mature worms, as is shown by their undeveloped vitelline glands and weakly outlined ovary and testes, has demonstrated that the position of the ovary may vary widely according to the age of the specimen. In one individual, which is 8.3 mm long and fully mature, the ovary is 3.2 mm from the anterior end. In another individual, 3 mm long but sexually mature as shown by the presence of eggs in the uterus, the ovary is 1.5 mm from the anterior end. From analogy with the nematodes this variation might be expected. In these worms it has been found that the anterior region of the worm changes but little after reaching sexual maturity, while the posterior end may enlarge considerably on account of the pressure of the enormous number of eggs.' So it might be expected that the posterior region of a *Cercorchis* worm would

enlarge relatively more rapidly, after reaching sexual maturity, than the anterior end, since the former is essentially a sac for holding the genital organs.

Cercorchis texanus resembles most closely *Cercorchis corti* described by Stunkard in 1916. The differences that seem to justify the erection of a new species are: The longer esophagus, more than twice as long as in *C. corti*, the longer metraterm, and the distribution of the vitellaria, which begin at a point more cephalic than in *C. corti.*

CERCORCHIS BAIRDI, new species

PLATE 2, FIGURE 7

Specific diagnosis.—Cercorchis: Sexually mature worms are 2.9 to 2.95 mm in length and 0.38 to 0.36 mm in width. The cuticular spines at the anterior end are very fine, scarcely distinguishable even with the aid of an oil immersion objective; the rows are less than 1μ apart. The oral sucker is usually wider than long, it varies from 72μ to 96μ in length and from 88μ to 114μ in width. The acetabulum is small and circular in outline. It measures 84μ in diameter. It is 0.46 to 0.5 mm from the anterior end. A prepharynx is lacking, and the pharynx is a globe measuring 40μ to 58μ in diameter. The esophagus is of medium length, varying from 63μ to 84μ. The intestinal ceca extend beyond the testes, and nearly to the posterior end. The ovary is globular in outline and lies on either side of the body. It is 80μ to 111μ in diameter and in my material is slightly caudal to the first third of the body length. The shell gland and ootype lie immediately behind the ovary. The ascending and descending coils of the uterus do not cross, but frequently they overlie the intestinal ceca. The metraterm is thrown into numerous waves. The eggs measure 32μ by 20μ. The vitellaria lie outside the intestinal ceca. Their farthest anterior extent is the level of the anterior margin of the ovary. Their farthest caudal extent is usually about the diameter of the anterior testis, cephalic to that organ. The testes are usually circular in outline, lying adjacent to each other, and of about equal size. They measure 0.13 mm in diameter. The cirrus sac is much coiled and stops well short of the ovary. It extends through four-fifths of the ovarian-genital pore distance. The vas deferens is not coiled.

Host.—Sternotherus carinatus.

Habitat.—Intestine.

Locality.—Huntsville, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30891.

Remarks.—This form resembles *Cercorchis medius* Stunkard (1916) very closely. It is, however, a slightly smaller form, the

esophagus is less than half as long as in Stunkard's species, the testes lie in juxtaposition, and the uterus overlies the intestinal ceca. Other differences, which may be of importance if checked carefully with a larger supply of material, are: The size and shape of the acetabulum, the distribution posteriorly of the vitellaria, and the positions in the body of the acetabulum and ovary.

The foregoing description is based on four specimens taken from a single turtle, which was given to me by Dr. Don. O. Baird, of the Sam Houston State Teachers College. I have, therefore, named the species in his honor.

CERCORCHIS ROBUSTUS Goldberger, 1911

This species was first described by Goldberger (1911); it was redescribed by Stunkard (1916). I have nothing to add to the description as revised by Stunkard. My specimens that are referred to this species come from the intestine of two examples of *Pseudemys elegans*, taken at Houston and Rosenberg, Tex.

Genus PROTENES Barker and Covey, 1911

The genus *Protenes* is very closely related to *Cercorchis*, from which it differs only in the position of the genital pore. The first known species was described by Stafford (1900) as *Distomum angustum* and the second by Barker and Covey (1911) as *Telorchis leptus*. These authors established for their species and Stafford's the subgenus *Protenes*. Stunkard (1916) raised *Protenes* to generic rank. The following adds the third species to this genus.

PROTENES CHAPMANI, new species

PLATE 2, FIGURE 8

Specific diagnosis.—Protenes: One worm measures 3 mm long by 0.4 mm in maximum width, and the other is 3.1 by 0.5 mm. The body is of relatively even breadth, the widest part being in the region of the ovary. Very small spines are buried in the cuticula. Near the oral sucker these spines are about 3μ long and arranged in rows about 3μ apart. Caudad the rows are farther apart; at the level of the genital pore they are about 5μ apart and at the level of the ovary 10μ apart. Beyond the ovary the rows become even farther apart until near the caudal end the spines disappear. The cuticula is about 2μ thick. The acetabulum is 0.77 to 0.88 mm from the anterior end; that is, about one-fourth the body length. It is circular and is 0.11 mm in diameter. The oral sucker is slightly larger and somewhat oval, the transverse diameter being the longer. It measures 0.13 by 0.15 mm in one specimen and 0.13 by 0.17 mm in the

other. The prepharynx is very short, being but 8μ to 10μ long. The pharynx varies in size from 76μ by 90μ to 72μ by 82μ. It is longer in the transverse diameter. Curiously, the pharynx of one specimen seems to be perfectly normal, while that of the other seems to be divided into quadrants as described by Barker and Covey (1911) for *Protenes leptus*. The length of the esophagus varies appreciably. In one specimen it is 0.18 mm long and in the other only 0.12. Oddly the small specimen has the longer esophagus. The intestinal ceca end in the posttesticular region near the caudal end of the body. The ovary is 1.14 to 1.08 mm from the cephalic end and 0.3 to 0.28 mm from the acetabulum. Therefore, it is slightly caudal to the end of the first third of the body length. It measures 0.12 by 0.09 mm. The structure in this region is very similar to that described by Barker and Covey. A short oviduct leads to the ootype directly caudal to the ovary, a well-developed Mehlis's gland surrounds the ootype while just at its caudal boundary it is joined by the common vitelline duct. A small vitelline reservoir is present. Laurer's canal leaves at this point, and in the one specimen in which it could be traced with certainty, it extended laterad, to open on the dorsal surface 84μ below the ovary, at the median edge of the intestinal ceca of the left side. The other specimen was mounted with the ventral side uppermost; and while the actual pore of Laurer's canal could not be seen, the duct could be traced to the same position. No seminal reservoir could be seen although the location was searched with an oil immersion objective. The upper part of the uterus and the proximal portion of Laurer's canal were filled, in both specimens, with a deeply staining mass, in appearance not unlike the tangled mass of spermatozoa in the male system of this fluke.

The uterus extends caudad in undulating coils on the left side of the body to the testes, then turns cephalad, and returns on the right side of the body. Cephalic to the ovary there are very few waves in the uterus. The metraterm is but poorly differentiated. The vitellaria are extra cecal in the lateral fields. Their most cephalic extent is slightly more than the width of the ovary posterior to that structure, and the most caudal extent is slightly more than the long diameter of the testis cephalic to the anterior testis. The testes lie in the posterior region in juxtaposition. They are oval bodies with the longest diameter in the transverse direction. They are of about equal size and measure 0.13 to 0.14 mm by 0.15 to 0.17 mm. The caudal testis is about twice its long diameter from the caudal end. As is usual for this genus the genital pore is in advance of the acetabulum, dorsal in position and near the lateral margin. In opposition to the other two known species, the cirrus sac and uterus of this species pass ventral to the right intestinal ceca, and both open

in the common genital pore near the right margin of the body. The cirrus sac is 0.46 to 0.42 mm long and contains in its caudal portion an elongate seminal vesicle. The excretory system is identical with that of *Protenes leptus*.

Host.—*Pseudemys elegans.*

Habitat.—Intestine.

Locality.—Rosenberg, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30893.

Remarks.—This species most closely resembles *Protenes leptus* Barker and Covey, but from this form it is readily distinguished by the location of the genital pore on the opposite side of the body, the location of the opening of Laurer's canal, and slight differences in the length of the cirrus sac and the location of the ovary and acetabulum. Apparently it is also a slightly larger form.

The two specimens upon which the above description is based were found in company with several examples of *Cercorchis texanus*, in a turtle, which T. S. Chapman sent me from Rosenberg, Tex.

Subfamily AURIDISTOMINAE Stunkard, 1924

Genus AURIDISTOMUM Stafford, 1905

This genus is represented by a single species, which is already known to be widely distributed.

AURIDISTOMUM CHELYDRAE Stafford, 1905

I have taken a single example of this parasite from the intestine of each of two snapping turtles, *Chelydra serpentina.*

Class CESTODA

Family PROTEOCEPHALIDAE La Rue, 1911

Genus PROTEOCEPHALUS Weinland, 1858

The unsettled condition of the classification of this genus has been thoroughly discussed by other authors. Meggitt (1927) lists the species and gives tables for their determination. It is sufficient to state here that all the following species definitely belong to Woodland's (1925) *Crepidobothrium* group, or, as it has been more generally known in the past, La Rue's (1914) genus *Ophiotaenia.*

PROTEOCEPHALUS MAGNUS (Hannum, 1925)

The original description of this species is based on a single specimen from the intestine of *Rana catesbeiana* from Oklahoma. I encountered a tapeworm in the same host at Huntsville, Tex., and

because of a number of differences between that worm and Hannum's description of *P. magnus* I at first believed it to be a distinct species. Later, however, I found three tapeworms in the intestine of *Rana clamitans*, at Houston, Tex.; and the variations exhibited by these three worms are such that only one important difference remains to be explained. Hannum states that the shell gland is represented by only a few unicellular glands, which are clustered about the caudal portion of the ootype, while in all my material a well-developed shell gland, which practically envelops the coils of the oviduct, is always present. I have noticed in other closely related forms, however, that the shell gland soon loses its property of retaining stains, and therefore a portion of it may easily be overlooked in a specimen that has been kept in a preservative for some time. Aside from this point there is such close correspondence between my material and Hannum's description that specific identity seems quite certain.

Variations in my material, which are strikingly greater than those recorded in the original description, are as follows: The testes vary from 98 to 190 to the segment; the main excretory ducts frequently run through the middle of the testicular field; the vagina usually opens anterior to the cirrus, but it may open beside or posterior to the cirrus; and the specimen from *Rana catesbeiana* is only 22 cm long. The three specimens from *Rana clamitans* are each about 65 cm long. The genital pore is commonly farther anterior than Hannum describes, frequently lying between the caudal borders of the first sixth and the first fourth of the lateral margins, but occasionally it is as far caudal as the union between the first and middle thirds of the segment. Furthermore, in Hannum's figure the genital pore is distinctly anterior to the caudal border of the first third of the lateral margin.

This marked extension of the limits of variation of *P. magnus* suggests the possibility that it may be synonymous with *P. filaroides* La Rue. When one considers the widely separated hosts, the remaining differences appear insignificant, but I have not seen any specimens of *P. filaroides*, and therefore hesitate to draw any definite conclusions.

PROTEOCEPHALUS FARANCIAE (MacCallum, 1921)

PLATE 3, FIGURE 1

My material, which is referred to this species, consists of fragments of a tapeworm taken from the intestine of *Farancia abacura*. The snake had been run over by an automobile when found and a portion of the intestine badly mutilated. Judged by the scoleces

found, there were five tapeworms in the snake, three of them Ophiotaenias, and two Oochoristicas, belonging to a species that will be described later in this paper.

MacCallum's (1921) original description of this tapeworm is based on a number of immature specimens, and is therefore quite inadequate. The points of interest mentioned in his paper are: Strobila 1 mm wide, genital pore irregularly alternating, head 0.6 mm wide, suckers 0.2 mm in diameter, a slight eminence (fifth vestigial sucker ?) present. This is admittedly not sufficient for certain identification, but since my material is from the same host species and agrees very closely with the characters given by MacCallum, I refer it to his species. A description of the material is given, as it is possible to make out some structures not mentioned by MacCallum, but this description is admittedly somewhat incomplete, because of the mutilated condition of the material.

Specific diagnosis.—Proteocephalus: A flat white tapeworm. The length can best be estimated by a single piece, with scolex attached, which measured 18 cm. The last segment of this piece was barely mature. Maximum width about 1.3 mm at the level of the first mature segments. The scolex is 0.5 mm wide. It bears a vestigial fifth sucker besides the usual four. The four suckers are about 0.2 mm in diameter. The neck is about the same width as the scolex and about 5 cm long. The first segments are much broader than long, and in them the rudiments of the genital organs are already present. They mature very slowly, however, and no mature segments are found until very near the end of the long piece mentioned above. When first mature the segments are somewhat longer than broad, measuring 1.85 by 1.3 mm. They gradually elongate as they mature until they measure 3.85 by 1 mm, when the testes first begin to degenerate. The genital pore lies between the caudal border of the first sixth and the first third of the lateral margin of the segment. It is relatively farther forward in the younger segments. The cirrus is very stout and usually protrudes; the ejaculatory duct is straight. The cirrus sac measures 0.28 to 0.32 mm in length and 0.09 to 0.11 mm in width. From the median end of the cirrus sac the coils of the vas deferens reach to the midline. The testes are very numerous and are crowded between the uterus and vitellaria. There are 390 to 420 testes to the segment, and about 60 per cent of these are on the aporal side. The testes vary from 0.09 to 0.32 mm in diameter. The vagina usually opens posterior to the cirrus sac, but segments in which it opens anterior to that structure are not uncommon. It lies ventral to the cirrus sac, but it curves dorsad over the vas deferens and lies on the dorsal side of the uterus. The bi-

lobed ovary extends nearly across the caudal end of the segment. The proximal portion of the oviduct is enlarged to form the so-called occapt. The oviduct makes two or three turns in the interovarian space before running anteriorly to the uterus. These coils of the oviduct form the ootype and are surrounded by a very diffuse shell gland, that can not be seen readily in whole mounts. The uterus extends from the ovary up the midline to the cephalic boundary of the segment. It has from 30 to 50 diverticula on each side. The vitellaria occupy the typical position for the genus. In a sectioned mature segment a very weakly developed layer of longitudinal muscle fibers could be seen. The relationship between these and the genital organs is in every way normal for the genus *Protocephalus* as defined by Woodland (1925). Ripe segments are lacking.

Host.—*Farancia abacura.*

Habitat.—Intestine.

Localities.—New York Zoological Gardens, New York City, and Houston, Tex.

Specimens.—U.S.N.M. Helm. Coll. No. 30896.

Remarks.—The most striking character of this worm is the large number of testes. The only rival in this respect is *P. gerrardii* (Baird), from which it differs in the shape of the suckers.

PROTEOCEPHALUS sp.

An immature specimen of this genus was removed from the intestine of *Anolis carolinensis.* Although several specimens of the host have been examined, this tapeworm has not been encountered a second time. Because no mature segments are present no description is attempted.

PROTEOCEPHALUS sp.

A single tapeworm of this genus, but without mature segments, has been removed from the intestine of *Terrapene carolina triunguis.*

Family ANOPLOCEPHALIDAE Cholodkowsky, 1902

Genus OOCHORISTICA Lühe, 1898

This rather large genus has hitherto been known from all the principal land masses except North America, but I have found it common in a number of species of snakes and lizards in Texas and have found it advisable to recognize five distinct species. As in many other tapeworm genera, classification is difficult because of the paucity of characters and the great individual variation that exists in the few characters present. The classification of the forms considered below is further complicated by the limited material, and

should more material become available it may be necessary to combine some of the forms that are here treated separately.

OOCHORISTICA NATRICIS, new species

PLATE 3, FIGURE 2

Specific diagnosis.—*Oochoristica:* A flat white worm. The total length is about 13 cm. The scolex is 0.5 to 0.6 mm in diameter. The suckers vary from 0.16 by 0.22 mm to 0.22 by 0.3 mm. They are, therefore, very large oval structures, with their long diameters lying parallel with the long axis of the worm. The neck is 0.3 to 0.35 mm wide and from 1 to 2 mm long. When the segments first appear they are very short. The mature proglottids appear some 30 to 40 mm from the scolex. They vary considerably in shape but are usually somewhat longer than wide. Extreme measurements for my material are 0.75 mm long by 0.80 mm wide and 0.105 mm long by 0.7 mm wide. The genital pore lies at the caudal border of the first fourth of the proglottid or slightly posterior to that level. The cirrus sac is an oval structure that measures 0.65 by 0.22 mm to 0.9 by 0.18 mm. A much coiled vas deferens, which acts also as a seminal vesicle, extends mesad from the inner end of the cirrus sac nearly to the median line. The testes lie in the caudal portions of the proglottid, but extend cephalad to or slightly beyond the caudal boundary of the ovary. There are 50 to 70 testes in each segment. The vagina opens into the genital atrium just caudal to the cirrus sac. As in other members of the genus it remains on the caudal side of the male ducts. Before reaching the median line the vagina curves caudal between the halves of the ovary and ends in a small seminal receptacle, lying ventral to the shell gland. The bilobed ovary and the vitellaria crowd the small shell gland between them. The ovarian complex is an oval mass measuring 0.3 by 0.6 mm. The sexual ducts pass between the main tubes of the excretory system. The ripe segments are about twice as long as broad. The eggs are scattered singly in capsules. They are 42μ in diameter; and their embryos are 20μ in diameter.

Host.—*Natrix rhombifera.*

Habitat.—Intestine.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30897.

Remarks.—This form most closely resembles *O. zonuri* Baylis, but it is a slenderer form with more elongate segments. In *O. zonuri* the scolex is 0.9 to 1 mm wide, and the maximum width is 3 mm. In *O. natricis* the scolex is only 0.6 mm wide, and the maximum width is less than 1 mm. There are structural differences in the distribution of the testes, size of cirrus pouch, and other minor features.

OOCHORISTICA ANOLIS, new species

PLATE 3, FIGURE 3

Specific diagnosis.—Oochoristica: A white flat tapeworm, with conspicuous segmentation. The total length of a specimen with ripe segments is 70 mm, and the maximum breadth about 1 mm. The scolex is 0.35 mm broad and distinctly marked off from the neck. The suckers are relatively very large, measuring 0.16 by 0.3 mm. The neck is 0.35 mm wide and about 2 mm long. As usual the first segments are wider than long. The first mature segments appear about 20 mm from the scolex, and they are about 0.95 mm long by 0.85 mm wide. The genital pore lies close to the caudal end of the first fourth of the proglottid. The cirrus sac is from 0.16 to 0.145 mm long by 0.11 to 0.09 mm wide. The vas deferens runs mesad to a point directly above the ovary and then turns caudad. The testes lie almost entirely caudal to the ovary, but caudal and lateral to the vitellaria. There are from 20 to 35 testes in each proglottid, and the testes are about 0.3 mm in diameter. The ovary is distinctly bilobed and about 0.35 mm wide. Directly caudal to it lie the shell gland and the vitellaria in the order named. The vitellaria measure 0.145 by 0.13 mm. A small seminal receptacle lies dorsal to the shell gland, and from this structure the vagina runs cephalad. At the cephalic margin of the ovary the vagina curves laterad. The sexual ducts pass between the longitudinal ducts of the excretory system, which is much branched and forms a network in each proglottid. The ripe proglottids are usually a little more than twice as long as broad. Within them the eggs are scattered singly in capsules. The eggs are about 64μ in diameter, and the embryos 40μ.

Host.—Anolis carolinensis.

Habitat.—Intestine.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30898.

Remarks.—The foregoing description is based on a single tapeworm and therefore gives no idea of the variation that may occur between different individuals of the same species. It is very similar to *O. fibrata* Meggitt, but it differs from this form in the size of the cirrus pouch and in the smaller number of testes. It is also closely related to the species from *Eumeces* described below, under which the relationship of these forms is more fully discussed.

OOCHORISTICA EUMECIS, new species

PLATE 3, FIGURE 4

Specific diagnosis.—Oochoristica: A flat white tapeworm with distinct segmentation. The total length is 103 mm, but there are

no fully ripened segments present. The scolex is 0.5 mm wide, and distinctly marked off from the neck. The suckers are large, but not so large relatively as in *Oochoristica anolis*. They measure 0.22 by 0.26 mm. The neck is about 0.35 mm wide and about 2 mm long. It is rather difficult to tell just where segmentation begins, but as usual the first segments are much broader than long. The mature segments first appear about 65 mm from the scolex and continue through about 35 mm before the eggs appear and the sex organs begin to degenerate. In this worm the mature segments are somewhat broader than long. Extreme measurements are 0.8 to 0.9 mm in length and 1.18 to 1.2 mm in breadth. The genital pore lies at the end of the anterior fourth or fifth of the lateral margin. The cirrus sac is an elongate oval, measuring from 0.26 to 0.18 mm in length and from 0.06 to 0.07 mm in breadth. From its inner end a much coiled vas deferens runs mesad to disappear as it reaches the ovary. The testes lie caudal and lateral to the ovary and vitellaria. Frequently they extend cephalad nearly to the anterior border of the ovary, but occasionally they only reach the middle of the ovary. There are from 40 to 55 testes in each proglottid. The ovary lies rather far forward in the segment, its anterior margin lying at the level of the genital pore. It is a bilobed structure about 0.4 mm wide. Behind it lie the shell gland and vitellaria in the order named. A small seminal receptacle lies directly dorsal to the shell gland. From it the vagina runs, at first anteriorly between the lobes of the ovary, and then curves toward the lateral margin. The genital ducts pass between the lateral excretory tubes and dorsal to the nerve. No fully ripened segments are present so it is impossible to make any statements concerning them.

Host.—*Eumeces fasciatus.*

Habitat.—Intestine.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30899.

Remarks.—This description like the preceding is based on a single specimen. It, therefore, becomes necessary to regard this as a species inquirenda until more material is available for study. The differences noted between this form and the preceding lie in the number and distribution of the testes, the shape of the cirrus sac, the relatively broader segments, and the relatively smaller suckers. Most of these differences are the same as those pointed out as the important differences between *O. fibrata* and *O. anolis*. I do not, however, regard *O. eumecis* as identical with *O. fibrata*, because of the difference in the number and distribution of the testes. Unfortunately Meggitt does not mention the scolex in his description so it is impossible accurately to compare this structure in the two

species. Presumably, however, the scolex of *O. fibrata* is the same as that of *O. agamae* since Meggitt was unable satisfactorily to distinguish his form from *O. agamae* as described by Baylis. Therefore, we may surmise that the suckers of *O. fibrata* are similar to *O. agamae* and smaller than those of *O. eumecis*. It is admitted that these morphological differences are scarcely great enough to separate species, in a group as variable as tapeworms of the genus *Oochoristica*. If any two of the above-mentioned forms, however, are to be combined, it promptly becomes necessary to refer three of them to the same species. The result would be that forms from a Burmese amphibian and North American lizards would be referred to a single species. The identity of these forms seems very unlikely, so it appears best for the present to consider all three as separate species, although their characters are rather unsatisfactory.

OOCHORISTICA AMERICANA, new species

PLATE 3, FIGURE 5

Specific diagnosis.—Oochoristica: A flat white worm, with distinct segmentation; the total length is 40 mm, but no ripe segments are present. The scolex is 0.5 mm wide, but it is not distinctly marked off from the neck. The suckers are small and circular; they measure 0.16 mm in diameter. Segmentation first appears about 3 mm from the scolex. Mature segments appear about 25 mm from the scolex. Even in the last segments available the uterus has not commenced to develop. The mature segments are about 1.1 mm long and 0.85 mm broad. The genital pore lies slightly caudal to the first fourth of the lateral margin. The cirrus pouch is large, measuring 0.2 by 0.09 mm. From it the coiled vas deferens extends mesad. The testes lie beside and behind the female glands. The most anterior of the testes lie behind the middle of the ovary. There are 35 to 40 testes in each segment. They frequently overlie one another slightly, especially in the younger segments. The ovary is a bilobed structure, lying in the caudal portion of the first half of the segment. It is about 0.35 mm wide. Behind it lie the shell gland and vitellaria, in the order named. The sex ducts pass between the longitudinal excretory tubes.

Host.—Farancia abacura.

Habitat.—Intestine.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 30900.

Remarks.—This form is very similar to *O. anolis* and *O. eumecis*; from the former it is distinguished by the greater number of testes, and from the latter by the lesser number of testes. It differs from

both species in having much smaller suckers. There are also differences in the size of the cirrus sac and the position of the genital organs.

OOCHORISTICA ELAPHIS, new species

PLATE 3, FIGURE 6

Specific diagnosis.—Oochoristica: A slender, white, semitranslucent tapeworm. Length 65 to 75 mm. The scolex is about 0.35 mm wide and bears four circular suckers about 0.145 mm in diameter. The neck is not sharply marked off from the scolex. It seems to be 5 or 6 mm long. The mature segments are nearly square, about 0.75 mm each way. The genital pore is slightly posterior to the end of the first fourth of the lateral margin. The cirrus sac is 0.145 mm long by 0.068 mm wide. The vas deferens is a much convoluted structure extending mesad to the ovary where it vanishes. The testes are very variable. The extreme counts are 30 to 53. They overlap one another and the shell gland, so that counting is more difficult than usual. The ovary is a bilobed structure lying near the center of the segment. It is about 0.3 mm broad. Behind it lie the shell gland and vitellaria. The vitellaria are more extensive than usual. Not only do they underlie the testes but they extend laterad as far as or farther than the ovary. The vagina starts from a seminal receptacle dorsal to the shell gland, and runs first cephalad, then curves laterad around the lobe of the ovary, and finally opens into the genital atrium just posterior to the cirrus sac. Both genital ducts pass between the lateral tubes of the excretory system. The ripe segments are about one and one-half times as long as broad, and are crowded throughout with eggs. The eggs measure about 50μ in diameter and the embryos about 34μ.

Host.—Elaphe obsoleta lindheimerii.

Habitat.—Intestine.

Locality.—Houston, Tex. (Houston Zoological Gardens).

Type specimen.—U.S.N.M. Helm. Coll. No. 31676.

Remarks.—The snake from which the type material was taken died in the Houston Zoo. Presumably it was captured somewhere in the vicinity of Houston, but the exact locality is unknown. It had refused to eat during several weeks of captivity, and this fact may have affected the tapeworms somewhat. The worm most closely resembles *Oochoristica americana* described above. Like this form the testes are distributed in more than one layer, but in *O. elaphis* the vitellaria are much more extensive and underlie the testes. Furthermore, *O. elaphis* seems to be a much smaller and more delicate form.

DIOCHETOS, new genus

Generic diagnosis.—Linstowinae: With relatively few elongate segments. Mature segments two to six times as long as broad. Genital pores alternate irregularly, and the sexual ducts pass dorsal to the single lateral excretory duct. The dorsal excretory ducts and secondary ramifications are usually absent except at the extremities of young worms. Testes very numerous with a tendency to arrangement in two lateral fields. Ovary median and very small. About the anterior two-fifths of a mature segment is unoccupied by the sex glands. Uterus breaks up into capsules, each of which contains a single egg. The capsules are evenly distributed but very sparse. Adults parasitic in lizards of the genus *Phrynosoma*. The above diagnosis is based on a single species, and will doubtlessly have to be modified if other species are discovered.

Type species.—*Diochetos phrynosomatis*, new species.

DIOCHETOS PHRYNOSOMATIS, new species

PLATE 3, FIGURE 7; PLATE 4, FIGURE 1

Specific diagnosis.—*Diochetos:* A flat white tapeworm, composed of relatively few elongate segments. The total length varies from 55 to 70 mm. The scolex is 0.4 to 0.6 mm wide, and the suckers are only 0.145 to 0.16 mm in diameter. There is no line of demarcation between the neck and the scolex. Segmentation becomes apparent about 2 mm from the scolex; and almost immediately the rudiments of the sex organs appear. The mature segments are 15 or 20 mm from the scolex. They vary considerably in length but are always much longer than broad. In my material, segments in which the uterus has not yet developed may be as much as six times as long as broad; younger segments, which seem to be perfectly mature, are not quite three times as long as broad. Extreme measurements are 1 by 6.1 mm for the older segments and 1 by 2.45 mm for the younger. The genital pore lies between the end of the first fifth and the end of the first third of the lateral margin. The cirrus sac is an oval measuring from 0.13 by 0.22 mm to 0.18 by 0.3 mm. The vas deferens lies directly posterior to the median end of the cirrus sac. It is at first much coiled, but straightens before reaching the level of the ovary. There are 125 to 180 testes in each segment. These lie almost wholly posterior to the ovary, but in nearly every segment a few lie cephalic to that organ. They tend to group themselves in two elongate lateral fields. The ovary lies slightly anterior to the center of the segment. It is bilobed and relatively small, about 0.25 mm wide. Behind it lie the vitellaria and shell gland in the usual positions.

The ripe segments are four to six times as long as broad, and the eggs are scattered sparsely throughout. The eggs are 55μ in diameter, and the embryos are 30μ in diameter. The excretory system is very unusual. Plate 4, Figure 1, is a diagrammatic reconstruction of a terminal segment of a young worm studied in sections. At the caudal end of the terminal sterile segment there are the usual median bladder and pore. Four excretory tubes of approximately equal size, one pair dorsal to the other, leave the bladder but very quickly come together to form a single pair of tubes. These again split apart and come together again, a process that is repeated several times. By the time the end of the terminal fourth of the segment is reached, however, the dorsoventral splitting ceases, and the tubes are single on each side throughout the rest of the segment. At irregular intervals throughout the worm, however, the tubes split again into dorsal and ventral parts for short distances, and in one instance such a split forms a loop through which the reproductive ducts pass. There are also some branch tubes that form anastomoses in the median portion of the worm, but these are rather infrequent. A scolex with about 3 mm of neck was sectioned, and throughout this area the usual dorsal and ventral excretory ducts were present. It is evident, therefore, that the single pair of tubes existing throughout the greater part of the worms represents a fusion of dorsal and ventral vessels, this fusion being not quite complete.

Host.—*Phrynosoma cornutum.*

Habitat.—Intestine.

Locality records.—Houston and Anderson, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 31677.

Family NEMATOTAENIIDAE Lühe, 1910

Genus CYLINDROTAENIA Jewel, 1916

This genus was proposed by Jewel for a single species, taken from the intestine of various North American amphibians. More recently Joyeux (1924) has reported it from South Africa.

CYLINDROTAENIA AMERICANA Jewel, 1916

Specimens taken from *Acris gryllus*, *Hyla squirella*, *Pseudacris triseriata*, and *Leiolopisma laterale* are referred to this species. It is perhaps a little surprising to find an amphibian cestode in a reptile, but in every detail of the anatomy the worms from *Leiolopisma laterale* matched Jewel's description, and the measurements fell within the variations which she recorded.

It is interesting to recall Joyeux's (1924) comparison between his material from African amphibians and Jewel's description. The dis-

crepancies that Joyeux noted are so great that specific identity seems very unlikely, particularly since a form discovered from an American reptile appears so similar.

Genus CYSTICERCUS Rudolphi, 1809

CYSTICERCUS sp.

PLATE 4, FIGURES 2, 3

A larval cestode was encountered three times, twice in *Leiolopisma laterale* and once in *Eumeces fasciatus.* It was found lying free in the body cavity or entangled in the mesenteries; in all three cases it was present in great abundance. The cyst is a white globular structure about 0.6 mm in diameter and exhibits very little movement when removed to a dish of water. The unarmed scolex lies entirely free within the cyst wall. This type of larval form corresponds to the group of cysticercoids which Villot (1883) designated by the name *Monocercus.* The known members of this group include the larval forms of certain species of *Anomotaenia.* The unarmed scolex and the occurrence of the cysts in lizards suggest the possibility of this form being the larval stage of an *Oochoristica.*

Class NEMATODA

Family RHABDIASIDAE Railliet, 1915

This family is not recognized by Baylis and Daubney (1926), but it seems to the author that its peculiar life history and the structure of the parasitic form justify the recognition of a family for this group of worms.

Genus RHABDIAS Dujardin, 1845

The presence of members of this genus in the lungs of the North American frog has long been known, but until recently they were regarded as specifically identical with *R. bufonis* of European Amphibia. Two other species of *Rhabdias* have recently been described from South America, which bring to three the total number of species from the Americas. Two of these three species were found locally.

RHABDIAS RANAE Walton, 1929

This parasite has been found in the lungs of *Rana catesbeiana* and *R. sphenocephala,* which were captured in the region of Houston, Tex., and from the former host at Huntsville, Tex.

RHABDIAS VELLARDI Pereira, 1928

Parasites referred to this species have been taken from the lungs of the following snakes: *Heterodon contortrix*, *Storeria dekayi*, *Potamophis striatulus*, and *Thamnophis proximum*. Two differences were noted between Pereira's description and my material, but it is believed that both may be explained without the erection of a new species. The measurements of the cephalic glands were found to be approximately ten times as great in my material as those given by Pereira, but on comparison with the figure it became at once apparant that Pereira had misplaced the decimal. The uterus in my material was often empty, and in no case did it contain as many as a dozen eggs. But since the uteri are never distended, as they are in Pereira's figures, I considered this difference too small for the erection of a new species.

Family ASCARIDAE Cobbold, 1864

Subfamily ASCARINAE Travassos, 1913

Genus OPHIDASCARIS Baylis, 1921

OPHIDASCARIS sp.

A single female nematode, which was taken from the stomach of *Coluber constrictor flaviventris*, is referred to this genus. The mouth has a very different appearance from that figured by Walton (1927) for *Ophidascaris labiatopapillosa* from the same host, and therefore the parasite is thought to belong to another species. A brief description of the worm is given, to aid in its later classification.

Length, 90 mm; cuticular striations about 60μ apart, but not very conspicuous. The three lips each bear two papillae. Interlabia are present. The esophagus is 4.9 mm long. The nerve ring and excretory pore are 0.75 and 0.85 mm from the anterior end, respectively. The vulva is in the posterior part of the body about 60 mm from the lips. The eggs are apparently unfertilized and measure 85μ in diameter. The tail is very short and blunt. It is 0.3 mm long.

Genus POLYDELPHIS Dujardin, 1845

POLYDELPHIS sp.

Two males and three females, all immature, were taken from the body cavity of *Coluber constrictor flaviventris*. The location is very unusual for a worm of this group, but as the snake had been dead for 24 hours before it was examined, it is possible that the parasites had migrated from their typical habitat in the intestine, much after the manner of *Ascaris lumbricoides*. These parasites could not be

identified with any known *Polydelphis* species, and because of the immature condition of the worms it is believed better not to name them at this time. A brief description is added, however, to aid in their future classification.

When alive the worms are light yellow. The cuticula is marked with numerous fine longitudinal striations.

Male: Length 35 to 40 mm; width about 0.7 mm. The esophagus is 2.5 mm long. The nerve ring is 1.2 mm from the anterior end. The tail is 0.185 mm long and ends in a short spike about 25μ long. The spicules are equal, 0.4 mm long, and 25μ wide. There are two pairs of lateral papillae placed just anteriorly to the base of the tail spike, and two rows of papillae running from behind the anus anteriorly. These rows are very irregular and 44 papillae could be counted in one row, but only 23 in the other.

Female: In only one specimen were the female genital organs sufficiently developed to count the number of uteri. A description of this one is given. Length 53 mm. Esophagus 2.6 mm long. Nerve ring and excretory pore 1.2 and 1.85 mm, respectively, from the anterior end. The vulva is 24.5 mm from the anterior end, and from it the ovejector runs posteriorly for 0.55 mm before giving rise to four uteri by dichotomous branching.

Polydelphis anoura has been reported from several North American snakes, and by Baylis (1921) is doubtfully reported from the above-mentioned host. The spicules, however, clearly separate this form from *P. anoura*.

Family KATHLANIIDAE Travassos, 1918

Genus FALCAUSTRA Lane, 1915

This genus has been considered a synonym of *Spironoura* by many recent authors. *Spironoura*, as erected by Leidy (1856), contained two species, *S. gracile*, type species, from the stomach of *Emys serrata*, and *S. affine* from the cecum of *Cistodo carolina*. Only the latter species has subsequently been found and redescribed. Boulenger (1923) redescribed it under the name of *Falcaustra chapini*, but Chapin found it to be the only parasite present in the ceca of box turtles in the vicinity of Washington, D. C., and on the strength of this evidence suggested that it was identical with *Spironoura affine*. He further suggested that *Falcaustra* Lane should be considered a synonym of *Spironoura* Leidy, but since Leidy's species *gracile* is the type, and this form has not since been studied, it would seem premature to dispose of the genus *Falcaustra* as a synonym of *Spironoura*. This opinion is further supported by an observation that Walton (1927) made on the existing Leidy collection of nematodes. For these reasons the genus *Falcaustra* is here retained.

FALCAUSTRA AFFINE (Leidy, 1856)

Worms that I have taken from the ceca of several specimens of *Terrapene carolina triunguis* agree very closely with the description given by Boulenger except for size. As none of Boulenger's material was fully mature, this discrepancy is rather to be expected. In my material males 10 mm long and females 11.5 mm long were not uncommon.

FALCAUSTRA PROCERA (Canavan, 1929)

I have taken specimens that agree very closely with Canavan's description of this species from the rectum of *Pseudemys elegans*. Only in the length of the male tail is there a conspicuous difference. Canavan gives the total length as 13 mm and the length of tail as 1.4 mm, but the tail of a specimen 13.8 mm long in my collection measures only 0.75 mm. However, if one measures the male tail figured by Canavan, he finds that its length falls very close to 0.8 mm.

Canavan considers his species to be most closely related to *Falcaustra testudinis* Baylis and Daubney, but I find it very difficult to distinguish it satisfactorily from *S. affine*. As I have stated above, fully matured specimens of *S. affine* are much larger than those which Boulenger described. Between these larger specimens and *S. procera* I could find only slight differences in lengths of the esophagus and of the tail. These are certainly sufficient to warrant the erection of a subspecies, but I have some little doubt if they are of full specific value. Table 1 gives the more important measurements and represents the extremes found in measuring five examples of each sex of each species.

TABLE 1.—*Comparison of measurements of* Falcaustra affine *and* F. procera *(five examples of each sex)*

Species	Total length		Length of esophagus		Length of tail		Ratio of length of tail to length of esophagus	
	Male	Female	Male	Female	Male	Female	Male	Female
	Mm	*Mm*	*Mm*	*Mm*	*Mm*	*Mm*		
F. affine	8. 55-10. 3	11. 3-11. 4	2. 3-2. 54	2. 54-2. 6	0. 37-0. 5	0. 75-0. 85	1:5-1:6. 3	1: 3-1:3. 4
F. procera	8. 7-13 7	8 .6-14. 5	1. 75-2. 2	1. 7-2. 3	0. 55-0. 73	0. 67-1. 35	1:3-1:3. 8	1:1. 7-1:2. 5

FALCAUSTRA CHELYDRAE, new species

PLATE 4, FIGURE 4

Specific diagnosis.—Falcaustra: A slender white nematode with a finely striated cuticula. The mouth is surrounded by three large lips each of which bears two forked papillae. The esophagus con-

sists of three parts, a pharynx, a cylindrical midportion, and a terminal hourglass-shaped bulb. The tail of both sexes is sharply pointed.

Male: 10 to 12.5 mm long and about 0.4 wide. The pharynx is about 0.1 mm long, and the entire esophagus varies from 2 mm to 2.25 mm in length. The hourglass-shaped bulb is 0.39 to 0.44 mm long and 0.22 to 0.24 mm wide. The nerve ring and excretory pore are about 0.44 and 1.3 mm, respectively, from the anterior end. The tail measures 0.42 to 0.5 mm in length. The spicules are 3.4 to 3.9 mm long, about 40μ wide near the anterior end, and plainly cross-striated. The gubernaculum is about 0.17 mm long. The papillae are very similar in arrangement to those of *S. affine.* There are two ventral pairs placed slightly beyond the middle of the tail, and at the same level a subdorsal pair. There are three ventral pairs, placed close together just caudal to the cloacal opening, and again at the same level a subdorsal pair. There are three pairs of preanal papillae, but in this species they are not evenly spaced. The anterior two pairs of these rows are farther apart than the posterior two pairs. A precloacal sucker is plainly outlined by the musculature, but it does not possess a cutinous rim.

Female: 12.5 to 13.75 mm long, and 0.5 to 0.55 mm wide. The pharynx is about 0.13 mm long, and the esophagus is 2.33 to 2.52 mm long. The hourglass-shaped bulb measures 0.4 to 0.51 mm by 0.24 to 0.26 mm. The nerve ring and excretory pore are 0.45 and 1.3 mm, respectively, from the anterior end. The vulva is 8.5 to 9 mm from the anterior end, and therefore lies close to the cephalic end of the caudal third of the body. The tail is 0.6 to 0.75 mm long.

Hosts.—*Chelydra serpentina* and *Amyda ferox.*

Habitat.—Rectum.

Localities.—Houston, Tex., and Whitehall, N. Y.

Type specimen.—U.S.N.M. Helm. Coll. No. 31699; paratype, No. 31700.

Remarks.—This species very closely approximates in size and in many structures *Falcaustra affine* and *F. procera*, but from these it is easily distinguished by the extremely long spicules.

FALCAUSTRA CATESBEIANAE Walton, 1929

This is a very common parasite of the bullfrog (*Rana catesbeiana*) both at Houston and at Huntsville, Tex.

Genus CRUZIA Travassos, 1917

Until recently this genus has contained only one species, *Cruzia tentaculata* from opossums, but Maplestone (1930), Khalil (1926), and Khalil and Vogelsang (1930 and 1932) have raised the total

number to six. Likewise, the host list for the genus has increased until it now includes several mammals of diverse groups and one reptile, a Mexican lizard. In the rectum of a turtle I found a species that so closely resembles *Cruzia tentaculata* that it was at first referred to that species. Indeed, the American representatives of this genus are very similar to one another, notwithstanding the diversity of their hosts. The genus is well characterized by an intestinal diverticulum, that projects into the esophageal region. So pronounced is this character that some authors have recognized a separate family, Cruziidae, based on it, while others have included the genus in the Kathlaniidae. I have followed the latter course, as the presence or absence of a diverticulum does not seem to me to be of more than generic rank.

CRUZIA TESTUDINIS, new species

Specific diagnosis.—Cruzia: The parasite is a smooth, white worm, somewhat attenuated at the ends. The greatest diameter lies just caudal to the end of the esophagus. The cuticula is smooth and thick. The mouth is surrounded by three large triangular lips, each of which bears near its inner angle a pair of conspicuous papillae. Aside from these there are two double papillae on the dorsal lip, and another, likewise double, on each of the subventral lips. Each subventral lip also bears an amphid. This organ opens by a minute pore near the summit of a large papillalike prominence.

Male: Mature males vary from 7.3 to 13.5 mm in length and from 0.4 to 0.6 mm in width. The entire esophagus is from 1.8 to 3.17 mm long. It is divided into four parts: The first part, or pharynx, is 0.2 to 0.29 mm long; the second tubular part is 1.17 to 2.5 mm long; the third part, a small bulb, is 0.07 to 0.15 mm long; and the fourth part, a large bulb, is 0.27 to 0.31 mm long. The nerve ring is 0.47 to 0.77 mm, and the excretory pore is 0.8 to 1.4 mm, respectively, from the cephalic end. The intestinal diverticulum varies from 0.5 to 1.1 mm in length. The male tail bears nine papillae, which are distributed exactly as in the well-known *Cruzia tentaculata.* The spicules are 0.76 to 1.05 mm long, and the gubernaculum is 0.13 to 0.16 mm long. The tail is 0.13 to 0.19 mm long, sharply pointed, and curved slightly ventrad.

Female: The female is 10 to 15 mm long and 0.4 to 0.65 mm wide. The esophagus is 3 to 3.8 mm long, of which 0.25 to 0.32 mm is pharynx, 2.3 to 3 mm is narrow, tubular portion, 0.09 to 0.13 mm is the small bulb, and 0.32 to 0.36 mm is the larger caudal bulb. The intestinal diverticulum is 0.85 to 1.2 mm long. The nerve ring is 0.54 to 0.66 mm, and the excretory pore is 1.34 to 1.71 mm from the anterior end, respectively. The vulva lies near the middle of the body, usually a trifle caudal of the middle in young worms and

a trifle cephalic in old ones, but in no case was it observed more than 1 mm from the middle. The female tail varies from 0.3 to 0.5 mm in length. The ova measure 60μ to 70μ wide by 100μ to 130μ long.

Host.—*Terrapene carolina triunguis.*

Location.—Rectum.

Locality.—Houston, Tex.

Type specimens.—U.S.N.M. Helm. Coll. No. 3173; paratypes, No. 3174.

Remarks.—These nematodes occurred in large numbers in the recta of nearly all the hosts examined. They are remarkably similar to *Cruzia tentaculata*, for careful study has shown only one constant difference between the two forms. The female tail of *Cruzia testudinis* varies from 0.3 to 0.5 mm in length, and its ratio to the total length varies from 1:28 to 1:40. The female tail of *Cruzia tentaculata* varies from 0.6 to 1 mm, its ratio to the body length varies from 1:14 to 1:18. There are also average differences in the length of the esophagus, but here the variation is too great for the character to be of any importance. So striking is the similarity between these two species and so slight are the differences that the writer would still consider them to be cospecific were it not for the great phylogenetic separation of the hosts.

Family OXYURIDAE Cobbold, 1864

Subfamily Oxyurinae Hall, 1916

Genus PHARYNGODON Diesing, 1861

This genus has been unknown in North America until very recently. Walton (1929) described *P. bratrachiensis* from the tadpoles of *Rana pipiens*. Walton, however, had only female specimens on which he based his description, and while they are very similar to the females of *Pharyngodon*, they show certain peculiarities not found in other members of the genus.

With this possible exception the genus is represented only in lizards. The excretory pore and the vulva are unusually posterior in position, and the plugs in the eggs are in the inner instead of the outer membrane. Most of these differences were pointed out by Walton, and while they do not necessitate the removal of the worm from the genus at this time, the discovery of the male may make such a change necessary.

PHARYNGODON WARNERI, new species

Plate 4, Figures 5, 6

Specific diagnosis.—*Pharyngodon:* White, stout nematodes, usually showing marked cross striations of the cuticula near the cephalic end

but gradually growing fainter caudad. The esophagus has the characteristic bulb, and just behind that structure the excretory pore opens on the ventral surface.

Male: Length 2.25 to 3 mm; width 0.15 to 0.17 mm. The esophagus is 0.5 to 0.51 mm long, and the bulb measures 84μ to 92μ by 108μ to 116μ. The nerve ring is 0.16 to 0.2 mm from the anterior end, and the excretory pore 0.8 to 1.1 mm. The male tail ends rather bluntly and is 0.1 to 0.125 mm long. The cloacal opening is surrounded by the usual three pairs of papillae. The pedicles of the preanal pair are dome-shaped. The next pair caudad has long stout pedicles. while those of the caudal pair are very much bent. Both of the more caudal pairs are included in the caudal alae. No spicule could be seen, and if present it must be imperfectly cutinized. A well-developed genital cone is present and is about 17μ long. A cuticular fold, starting at the base of the cone, overlies a part of its ventral surface. The distal end of the fold is emarginate and at each side more or less pointed. The internal male genital organs are of the ordinary type. A seminal vesicle is preceded by the single testis, whose most cephalic extent is about 0.2 mm posterior to the excretory pore.

Female: Body length 3.4 to 4.6 mm; width 0.13 to 0.2 mm. The esophagus is 0.55 to 0.7 mm long; the nerve ring and the excretory pore are 0.16 to 0.18 and 0.9 to 1.05 mm, respectively, from the anterior end. The esophagus ends in a characteristic bulb 0.114 to 0.125 mm wide and 0.125 to 0.14 mm long (the length includes the narrow anterior neck of the bulb). The vulva, as in most members of this genus, follows immediately after the excretory pore. It is 1 to 1.2 mm from the lips. The vagina extends along the ventral body wall about 0.75 mm, then crosses over and gives rise to the two divergent uteri, which in turn give rise to the ovaries. Because of the excessive number of eggs in the uteri, it is impossible to trace out their convolutions accurately in whole mounts. The female tail is unusual for the genus, for instead of narrowing abruptly just behind the anus it tapers gradually to a sharp point. It is 0.5 to 0.7 mm long. The eggs have the usual plugs in each end; they vary from 125μ by 34μ to 130μ by 36μ.

Host.—*Cnemidophorus sexlineatus.*

Habitat.—Rectum.

Locality.—Huntsville, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 31701.

Remarks.—This species belongs to that group of the genus *Pharyngodon* in which the caudal papillae are included in the caudal membrane. These include the species *hindlei*, *mamillatus*, *spinicauda*, *inermicauda*, and *tiliquae*. From all these, as well as from *P. batra-*

chiensis, known only by females, it is distinguishable by the shape of the female tail. Furthermore, the species is separated from *P. mamillatus* and *P. inermicauda* by the width of the lateral alae; from *P. spinicauda* and *P. tiliquae* by the lack of a support for the anterior margin of the bursa; and from *P. hindlei* by the latter's conspicuous spicule.

Two of the 6-lined race runners examined were heavily parasitized by this worm. Race runners are rare about Houston but are very common at Huntsville, Tex., where these specimens were collected. I am greatly indebted to Dr. S. D. Warner, of the Sam Houston State Teachers' College, for assistance given me while collecting in that locality, and I name this species in his honor.

Genus COSMOCERCOIDES Wilkie, 1930

This genus was erected for two species of Oxyuridae from Japanese amphibians. It is distinguished from *Cosmocerca* by the absence of true plectanes and by the presence of a ring of tubercles about the base of the large papillae. No mention is made in the description of the genus *Oxysomatium*, yet this genus can only be distinguished from *Cosmocercoides* by the presence in the latter of the above-mentioned tubercles. In certain specimens, which I have obtained from the blue-tailed skink, and which are described more fully below, these tubercles may be lacking. Since the worms from this host are all very small and appear to retain juvenile characters after reaching sexual maturity, it seems not unlikely that they are in an unsuitable host. Until more knowledge concerning their relationship to the normal members of the species is obtained, however, it seems best to recognize *Cosmocercoides* as a genus for those forms possessing cuticular tubercles about the base of certain large papillae.

COSMOCERCOIDES DUKAE (Holl, 1928) Travassos, 1931

Synonyms: *Cosmocerca dukae* HOLL, 1928; *Oxysomatium variabilis* HARWOOD, 1930.

As Wilkie has suggested, this species should be transferred to his new genus *Cosmocercoides*. Holl's type material came from *Triturus viridescens*, which does not occur in this vicinity; but I have found the same species of parasite very common in other hosts. Unfortunately I was not aware until recently of Holl's species, and I described this worm separately under the name of *Oxysomatium variabilis*. Although it is an extremely variable form, there can be no doubt that Holl and I described the same species, and as Holl's name has priority it must stand. Accordingly *Oxysomatium variabilis* Harwood, 1930, falls as a synonym of *Cosmocera dukae* Holl, 1928.

In the paper referred to (Harwood, 1930) I have recorded this species from a considerable number of amphibians and reptiles, and several others have been added since. The complete host list is now as follows: *Triturus viridescens*, *T. meridionalis*, *Ambystoma microstomum*, *A. talpoideum*, *Hyla squirella*, *Pseudacris triseriata*, *Rana areolata*, *R. palustris*, *R. sphenocephala*, *R. sylvatica*, *R. clamitans*, *R. catesbeiana*, *Bufo valliceps*, *B. terrestris*, *Gastrophryne areolata*, *Ophisaurus ventralis*, *Leiolopisma laterale*, *Eumeces fasciatus*, *Heterodon contortrix*, *Storeria dekayi*, *Micrurus fulvius*, *Terrapene carolina triunguis*, and *Terrapene ornata*. It may be noted that the majority of these hosts are mainly terrestrial. *R. catesbeiana* is the most nearly aquatic host, but only a very light infection was encountered in 20 specimens of this frog examined. In the laboratory cultures the larvae do not develop in saturated soil.

An interesting variation of this species has been obtained from *Eumeces fasciatus*. The worms from this host are unusually small, the males being only 1.65 to 2.2 mm long. The spicules are variable, often being unequal. In one worm the long spicule was 0.233 mm long and the other only 0.166 mm long. The large papillae are often without the cuticular tubercles around them. All these characters appear, though seldom in such a pronounced manner, in immature worms from *Bufo valliceps*, a common host. The worms from *E. fasciatus*, however, are mature, as is shown by the presence of fertile eggs in the females. The females from this host are also very small.

Travassos (1931) gained the impression that I (Harwood, 1930) included a number of species in my discussion of *Cosmocercoides dukae*. It may be well to emphasize, therefore, that the recorded variations other than size can not be correlated in any way with the type of host invaded. Indeed, on studying material obtained by further collecting, those few groups mentioned by me (1930) have been found to be untenable. That free-living animals possessing a wide geographic range, and living under a variety of conditions, show a great range of variation is a well-known biological principle. Two examples come readily to mind; namely, *Melospiza melodia* among the birds, and *Papilio glaucus* among the insects. Accordingly, we might expect to find a great range of variation among those parasites that are able to invade a variety of host species. This has been amply demonstrated with *Syngamus trachea*.

Family ATRACTIDAE Travassos, 1920 (?)

Genus ATRACTIS Dujardin, 1845

This is a genus of very small worms that are parasitic in reptiles. Only one species, *A. opeatura* Leidy, has previously been described

from America. The following account contains the description of a second species, which is parasitic in the three-toed box turtle:

ATRACTIS CAROLINAE, new species

PLATE 4, FIGURE 7

Specific diagnosis.—*Atractis:* A very small, white, parasitic worm. Body cylindrical, and tapering at each end. Tail of both sexes sharply pointed. Cuticular striations faint and 1μ to 2μ apart. Mouth surrounded by six lips, each of which bears two papillalike protuberances at the distal end and two more just proximal to them. The esophagus is divided into two equal parts and ends in the usual bulb.

Male: Length 2.3 to 2.85 mm; width 63μ to 80μ. The esophagus is 0.48 to 0.55 mm long, and the bulb measures 75μ to 80μ long by 63μ to 75μ wide. The nerve ring and excretory pore are 0.35 to 0.38 and 0.375 to 0.415 mm, respectively, from the anterior end. The tail is 0.33 mm long. The spicules are very unequal, the long one being 0.333 to 0.34 mm long, and the short one only 75μ to 84μ long. The long spicule is well cutinized, conspicuously cross-striated, and about 10μ wide. The short spicule is but slightly cutinized and unmarked. The gubernaculum is 60μ to 80μ long and notched near the anterior end. There is a row of five papillae, placed close together on each side of the anus. There may be four more pairs of postanal papillae, but they are not always present.

Female: Length 2.5 to 2.95 mm; width about 85μ. Esophagus 0.47 to 0.57 mm long, its bulb measuring 71μ to 80μ long by 63μ to 71μ wide. The nerve ring and the excretory pore are 0.25 to 0.3 and 0.35 mm, respectively, from the anterior end. The vulva is only 63μ to 85μ in front of the anus. The tail is 0.5 to 0.55 mm long.

Host.—*Terrapene carolina triunguis.*

Habitat.—Rectum.

Locality.—Houston, Tex.

Type specimens.—U.S.N.M. Helm. Coll. No. 31702; paratypes, No. 31703.

Remarks.—These nematodes were always present in large numbers in the rectum of the host, but they are so small that at first they were passed over as larval forms of other nematodes present in the same host. Possibly other investigators have encountered this same form and have disregarded it for the same reason. This species may easily be separated from Leidy's *A. opeatura* by size, structure of lips, size of spicules, and number of papillae.

Family DIAPHANOCEPHALIDAE Travassos, 1919

Genus KALICEPHALUS Molin, 1861

The worms belonging to this genus are very widely distributed, but many of them are imperfectly known, having been inadequately described by earlier workers; and as yet no redescriptions are available. Only two species, *K. coronellae* and *K. parvus* Ortlepp (1923), have been adequately described from North America. MacCallum (1921) described a new species of nematode, *Strongylus boae*, from the stomach of *Boa constrictor*. He lists also a number of other snakes, many of them North American species, as hosts to this parasite. His description is very general, and it would be impossible to determine the genus of the worm were it not for the figure, which leaves no doubt that the worm belongs to the genus *Kalicephalus*. The name *boae* is preoccupied in this genus, and as both Molin and Blanchard have described worms of this genus from *Boa constrictor*, MacCallum's trophotype, it seems best to let MacCallum's species sink into synonymy with *K. boae* (Blanchard).

I have collected two species of this genus from Texas snakes, and both of them appear to be new. I have followed Ortlepp's example, however, and have disregarded Molin's species, which have not been redescribed, as none of my worms are from the same hosts and as his descriptions are too brief for purposes of modern taxonomy.

KALICEPHALUS AGKISTRODONTIS, new species

PLATE 5, FIGURE 1

Specific diagnosis.—Kalicephalus: A light orange or yellow nematode, with a smooth cuticula. The mouth capsule is typical for the genus. The dorsal gutter extends about half the distance into the mouth capsule. The esophagus is distinctly thickened in the posterior half. The nerve ring encircles the esophagus about one-third of the distance from its anterior end. The excretory pore is very faintly indicated and usually lies at the level of the thickest portion of the esophagus. The intestine is an inconspicuous tube among the reproductive organs and glands.

Male: Body length varies from 6.5 to 9.5 mm; the width from 0.2 to 0.3 mm. The buccal capsule is 0.13 to 0.16 mm long and of approximately the same width at the base. The esophagus is 0.31 to 0.34 mm long; the nerve ring is 0.22 mm to 0.28 mm from the anterior end, and the excretory pore 0.33 to 0.4 mm. The spicules are long, slender, and alate. They are 0.46 to 0.58 mm long and about 10μ wide at the anterior end. The alae are transversely striated. A well-cutinized gubernaculum is present, but its size is somewhat vari-

able. It measures 0.11 to 0.155 mm in length, and about 15μ at the widest point near the anterior end. The genital cone is 0.13 to 0.145 mm long and 0.09 to 0.11 mm wide at the base. The bursa is obliquely truncated; its rays are of the usual pattern. The common trunk of the dorsal ray usually bifurcates near its middle, and each branch almost immediately divides again. The inner rays are again divided for from one-half to one-third their length.

Female: The total length varies from 10 to 13.75 mm; width from 0.26 to 0.33 mm. The mouth capsule is 0.16 to 0.18 mm long and at the base about as broad as long. The esophagus is 0.35 to 0.47 mm long. The nerve ring and excretory pore are 0.28 to 0.32 and 0.4 to 0.51 mm, respectively, from the anterior end. The vulva is 7 to 9.13 mm from the anterior end and therefore in the posterior part of the body. The vulva divides the body in the ratio of 1.6:2; the lips of the vulva are very prominent, measuring about 0.11 mm in length. The uteri are divergent, and therefore this species falls into Ortlepp's group A. The rest of the female genital system is quite typical for the genus. The eggs measure 67μ to 75μ by 38μ to 46μ. The tail varies in length from 0.3 to 0.4 mm, and it ends bluntly.

Hosts.—*Agkistrodon mokasen*, *Heterodon contortrix*, *Pituophis sayi*, *Natrix rhombifera*, *N. sipedon fasciata*, *Lampropeltis getulus holbrooki*, *Thamnophis proximus*, and *Micrurus fulvius*.

Habitat.—Stomach.

Locality.—Houston, Tex.

Type specimens.—U.S.N.M. Helm. Coll. No. 31704; paratype, No. 31705.

Remarks.—This parasite closely resembles *Kalicephalus coronellae*, which Ortlepp found in the stomach of a North American snake (*Coronella triangulum*) dying in the Zoological Gardens of London. *K. agkistrodontis* is a much smaller form; the buccal capsule is more elongate; the female tail is much shorter (in actual measurement, but about the same proportionately); the spicules and gubernaculum are both shorter, in actual measurements, and the gubernaculum is shaped differently.

KALICEPHALUS AGKISTRODONTIS FLAGELLUS, new subspecies

Subspecific diagnosis.—These worms differ from the typical variety in the following respects: They are smaller, the males vary in length from 6.3 to 7 mm, the females from 6.72 to 8.15 mm. The female tail is shorter measuring 0.24 to 0.32 mm in length. The inner rays of the dorsal ray are divided for less than one-fifth their length, and in one specimen there is no bifurcation at all.

Hosts.—*Coluber flagellum* and *C. constrictor flaviventris*.

Habitat.—Stomach.

Locality.—Houston, Tex.

Type specimens.—U.S.N.M. Helm. Coll. No. 31706; paratype, No. 31707.

Remarks.—This subspecies is based on two males and three females from *C. flagellum* and a single male from *C. constrictor*. The differences mentioned above are believed to be too great to go unnoticed, and yet they are too variable and too near the type to justify the erection of a new species.

KALICEPHALUS RECTIPHILUS, new species

PLATE 5, FIGURE 2

Specific diagnosis.—*Kalicephalus:* A yellowish cylindrical worm, with a faintly striated cuticula. The striations are about 2μ apart. A large mouth, of a shape typical for the genus, is separated from the rest of the body by a slight constriction. The esophagus is short, and constricted where the nerve ring encircles it at the level of the union between the first and second thirds. The excretory pore is usually slightly below the widest part of the esophageal bulb.

Male: Length 5.3 to 5.7 mm, width 0.2 mm. The mouth capsule is 0.17 to 0.18 mm long and 0.18 to 0.2 mm wide. The esophagus is 0.22 to 0.23 mm long. The nerve ring and excretory pore are 0.28 and 0.33 mm, respectively, from the anterior end. The spicules are 0.28 to 0.3 mm long and provided with narrow, transversely striated alae. They are about 10μ wide near the anterior end. There is a well-cutinized gubernaculum, about 0 13 mm long and only about 3μ wide in lateral view, with a definite hook present near the anterior end. The bursa is obliquely truncate and, with the exception of the dorsal ray, typical for the genus. The main trunk of the dorsal ray is very short. It bifurcates immediately after the separation of the externo-dorsal rays, and almost at once the two branches again bifurcate. The inner rays are again bifid near the tip. The pattern of the dorsal ray is, therefore, very similar to that of *Diaphanocephalus galeatus*.

Female: Body length 6.9 to 7.7 mm; maximum width 0.22 to 0.26 mm. The mouth capsule is 0.2 to 0.22 mm long and 0.22 to 0.24 mm wide. The esophagus is 0.25 to 0.28 mm long. The nerve ring and excretory pore are 0.28 to 0.3 and 0.36 to 0.4 mm, respectively, from the anterior end. The vulva is 4 to 4.3 mm from the anterior end and divides the body in the proportions of 1.2 to 1.4:1. The ovejectors and uteri are divergent. The eggs measure 63μ to 71μ by 18μ to 22μ. They are in a very early stage of development when deposited. The female tail is 0.25 to 0.38 mm long and ends very bluntly.

Host.—*Coluber constrictor flaviventris.*

Habitat.—Rectum.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 31708.

Remarks.—The foregoing description is based on two males and three females taken from the rectum of a blue racer. Like the preceding species, it belongs to the group of *Kalicephalus* worms with divergent uteri. It is easily distinguished from *K. coronellae* Ortlepp and *K. agkistrodontis* by the smaller size, the shorter esophagus and spicules, the shape of the gubernaculum, the shape of the dorsal ray, the position of the vulva, and the blunt female tail.

Genus OSWALDOCRUZIA Travassos, 1917

A representative of this genus has been known from North America since the time of Joseph Leidy. It is now known by the name of *O. leidyi* Travassos, but, as Steiner (1924) has already pointed out, it is impossible as yet satisfactorily to distinguish this form from certain species described earlier. Recently Walton has reported several other species from this continent.

OSWALDOCRUZIA PIPIENS Walton, 1929

PLATE 5, FIGURES 3–6

The features used to differentiate *Oswaldocruzia pipiens* Walton and *O. leidyi* Travassos are not satisfactory in view of the variation present in my material. Walton (1929) lists "size, possession of distinct cervical alae, and decidedly different dorsal ray pattern" as the important differences between these forms. The difference in size between *O. pipiens* and *O. leidyi* is only an apparent one, since neither Walton nor Steiner records any variation in their measurements, while in my material the variation is nearly as great as the range between their measurements. The dorsal ray pattern is also variable. Of three males taken from *Terrapene carolina triunguis*, two had a pattern similar to that figured by Walton (1929) for *O. pipiens*, while one was similar to that figured by Steiner (1924) for *O. leidyi*; and of two males from a specimen of *Leiolopisma laterale*, one had a pattern similar to *O. pipiens*, and the other a pattern similar to *O. leidyi*. My material from other hosts is limited, but among these there is also a great variation of the dorsal ray pattern. The remaining character mentioned by Walton, the cervical alae, is always present in my material. Steiner mentions lateral alae, but he does not mention the cervical alae. Therefore, we may presume that they were absent in his material. It is, however, well to remember that Steiner published before Morishita (1926) had attached such great systematic importance to the cervical alae. For the present, therefore, it seems advisable to retain both *pipiens* and *leidyi* as separate species distinguishable by the presence or absence

of cervical alae. Since the size variations are not mentioned by either Walton or Steiner, it seems advisable to give those that I have found in my material.

Male: Length, 6 to 10.75 mm; width, 0.35 to 0.65 mm. The esophagus is 0.35 to 0.5 mm long. The cuticular expansions at the anterior end are 75μ to 120μ long; and the head is 38μ to 55μ wide. The nerve ring and excretory pore are 0.14 to 0.19 mm and 0.3 to 0.375 mm, respectively, from the anterior end. The spicules are 0.16 to 0.25 mm long and 25μ to 34μ wide.

Female: Length, 9.5 to 13.55 mm; breadth, 0.55 to 0.85 mm. The esophagus is 0.3 to 0.6 mm long. The cuticular expansions at the anterior end are 85μ to 125μ long; and the "head" is 40μ to 55μ wide. The nerve ring and excretory pore are 0.16 to 0.225 mm and 0.3 to 0.374 mm, respectively, from the anterior end. The vulva is 6 to 9.5 mm from the anterior end and divides the body as 1.8 to 2.6:1. The female tail is 0.26 to 0.32 mm long. The eggs are 42μ to 50μ wide by 75μ to 88μ long.

From the foregoing measurements it will be seen that my largest female is smaller than the average recorded by Walton, but as environment makes large differences in the size of nematodes I do not consider this significant.

I have taken these worms from *Bufo terrestris*, *B. valliceps*, *Rana palustris*, *R. sphenocephala*, *Leiolopisma laterale*, *Eumeces fasciatus*, *Terrapene carolina triunguis* and *T. ornata* at Houston, Tex.; from *Hyla cinerea*, *Rana sphenocephala*, *Sceloporus undulatus*, and *Leiolopisma laterale* from Huntsville, Tex., and from *Rana sylvatica* at Crown Point, N. Y.

Family SPIRURIDAE Orley, 1885

Subfamily PHYSALOPTERINAE Stossich, 1898

Genus PHYSALOPTERA Rudolphi, 1819

Of this large and widely distributed genus there has been until very recently only one well-described species, *Physaloptera phrynosoma*, from North American cold-blooded hosts. Walton (1927) has added several other species to this list.

PHYSALOPTERA SQUAMATAE, new species

PLATE 5, FIGURE 7

Specific diagnosis.—Physaloptera, group "didelphis." A slender, white nematode with very finely striated cuticula, reflexed over the lips. The lips are dome-shaped, and each bears a large outer tooth and three small, inconspicuous inner teeth. The nerve ring lies near

the union of the fourth and last fifth of the muscular portion of the esophagus. The cervical papillae lie near the posterior end of the muscular esophagus and the excretory pore is slightly farther posterior.

Male: Length 7.4 to 9.2 mm; width 0.3 to 0.4 mm. The muscular portion of the esophagus is 0.2 to 0.25 mm long, and the glandular portion is 1.43 to 2 mm long. The nerve ring and excretory pore are 0.2 to 0.25 and 0.4 mm, respectively, from the anterior end, The cervical papillae are about midway between these two structures. The tail is 0.28 to 0.35 mm long. The spicules are subequal, but as the two vary independently either the left or right may be the shorter. They are only 0.155 to 0.175 mm long. The left spicule is well cutinized and about 10μ wide near the anterior end. It widens a very little beyond its middle and ends in a moderately sharp point. The right spicule is poorly cutinized and about 13μ wide at its base. Beyond the middle it widens to a maximum of 25μ, then tapers to a sharp point. The usual caudal alae are present and are supported by four pairs of circumcloacal papillae. The inner surface of the alae is decorated with raised longitudinal ridges. There are three papillae on the cephalic cloacal lip, and two pairs of papillae on the caudal lip. Three pairs of papillae are evenly spaced between the cloaca and the tip of the tail.

Female: Length 9 to 14.2 mm; width 0.35 to 0.4 mm. The muscular esophagus is 0.27 to 0.33 mm long, and the glandular esophagus is 1.7 to 2.8 mm long. The nerve ring and excretory pore are 0.25 to 0.28 and 0.3 to 0.45 mm, respectively, from the anterior end. The cervical papillae are about halfway between these two structures. The vulva lies slightly behind the caudal limits of the first third of the body; it is nonprotuberant, and from it the vagina runs caudad for 1.35 mm. The two uteri are convergent. The eggs measure 25μ by 42μ. The female tail is 0.33 to 0.5 mm long and ends bluntly. The pores of the caudal glands are situated very near the tip of the tail.

Hosts.—*Leiolopisma laterale* and *Agkistrodon mokasen*.

Habitat.—Stomach.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 31711.

Remarks.—The host distribution of this species seems at present to be rather unusual, since it includes a snake and a lizard. It was this that suggested the specific name *squamatae*. The parasite was not present, however, in a very high proportion of the hosts examined, and doubtless it will be found in other reptiles of these groups.

In the structure of the mouth region this species can be distinguished from *P. phrynosoma* by the presence of the inner teeth, and

it is readily distinguished in both sexes by the structure of the caudal regions.

PHYSALOPTERA PHRYNOSOMA Ortlepp, 1922

This parasite has been taken from the stomach of *Phrynosoma cornutum* both at Houston and at Anderson, Tex. Judged by these and other records, it is a frequent and widespread parasite of *Phrynosoma* sp.

Genus THUBUNAEA Seurat, 1914

This small genus is closely related to *Physaloptera.* Hitherto it has been known by only three species, one from Africa and the other two from South America. The following account adds a new species, and extends the known geographic range of the genus to North America.

THUBUNAEA LEIOLOPISMAE, new species

PLATE 5, FIGURE 8

Specific diagnosis.—Thubunaea: A white worm with a very finely striated cuticula. The lips exhibit the usual three teeth, and around the base of the lips there is a slight thickening of the cuticula that is reminiscent of the cephalic collarette of the closely related genus *Physaloptera.* The nerve ring lies near the cephalic margin of the last fifth of the muscular esophagus, and the cephalic papillae lie at about the same level. The excretory pore lies near the union of the two parts of the esophagus.

Male: Length 8.7 to 9.9 mm, width 0.21 to 0.3 mm. The vestibule is about 42μ long, the muscular esophagus 0.21 to 0.27 mm long, and the glandular esophagus 1.55 to 1.75 mm long. The nerve ring and excretory pore are 0.21 and 0.25 to 0.265 mm, respectively, from the anterior end. The male tail is 0.145 to 0.22 mm long. The caudal alae are well developed, and as usual for the genus the inner side of the alae is strongly tuberculated. This makes the papillae very difficult to distinguish, and I am far from certain that the three pairs of stalked papillae and the five pairs of sessile papillae that are figured are the only ones present. Those papillae that are figured, however, could be seen fairly clearly. The spicules are unusually well cutinized for this genus. The right spicule is longer than the left, but the ratio varies in different individuals. The measurements are 84μ to 93μ for the right spicule and 50μ to 72μ for the left spicule.

Female: Length 13.4 to 14.8 mm, width 0.31 to 0.34 mm. The vestibule is 0.2 to 0.24 mm long, the muscular esophagus 0.31 to 0 34 mm long, and the glandular esophagus 2.36 to 2.45 mm long. The nerve ring and excretory pore are 0.285 and 0 31 mm to 0.34 mm,

respectively, from the anterior end. The vulva is 1.4 to 1.6 mm from the anterior end. From it the vagina runs posteriorly for about 1.3 mm, where it divides into the two convergent uteri. The egg-filled uteri occupy the middle third of the body. Following the uteri are two elongate sacs, the seminal receptacles, which are about 0.5 mm long and 0.11 mm wide. The ovaries lie coiled in the body, caudal to the seminal receptacles. The eggs measure 23μ by 38μ. The female tail is blunt and only 0.11 to 0.13 mm long.

Host.—*Leiolopisma laterale.*

Habitat.—Stomach.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 31712.

Remarks.—Two immature specimens of *Thubunaea* taken from the stomach of *Acris gryllus* may belong to this species. They possess a short vestibule, three teeth on the lips, and a cephalic collarette as the above species does, but, as the sexual organs have not yet begun to develop, it is impossible to be sure of their identity.

This species is easily separated from *Thubunaea pudica* and *T. parkeri* by the well-cutinized spicules and the cephalic collarette.

Family CAMALLANIDAE Railliet and Henry, 1915

Genus CAMALLANUS Railliet and Henry, 1915

This genus is represented in North America by several species that are parasitic in fishes and turtles. For our purpose only those parasitic in the latter hosts need be considered. Several species have been erected by Leidy, Magath, and MacCallum for these forms, but in the present state of our knowledge it seems best to include them all under one species.

CAMALLANUS TRISPINOSUS (Leidy, 1851)

Synonym: *Camallanus americanus* MAGATH, 1918.

A number of nematodes taken from turtles are tentatively referred to this species. The hosts are *Chelydra serpentina*, *Kinosternon subrubrum hippocrepis*, *Pseudemys elegans*, *Deirochelys reticularia* (?), and *Amyda ferox* (?) from Houston, Tex.; and *Chrysemys picta* from Newfane, N. Y. The worms from *Deirochelys reticularia* are all females, and those from *Amyda ferox* are immature, and therefore these two records must be regarded as doubtful. Among the worms of my material there seems to be a variation in the length of the spicules that is associated with the host. These spicule measurements are given in Table 2.

Table 2 shows that in length of spicules my parasites fall closer to *Camallanus americanus* Magath than to *C. trispinosus* Leidy. Wal-

ton (1927), however, has shown that the supposed differences in the mouth capsules of these forms are not reliable, which is substantiated by my material; and the spicules vary so widely as to be of little systematic value in this case. Furthermore, as the spicules are very difficult to measure, there is the possibility that Leidy's measurements are inaccurate. For these reasons it seems best to allow Magath's name to sink into synonomy as Walton has already suggested.

TABLE 2.—*Length of spicules in* Camallanus trispinosus *from five different hosts*

Host	Number of specimens	Length of long spicule	Length of short spicule
		Microns	*Microns*
Chelydra serpentina	5	580–650	264–300
Kinosternon subrubrum hippocrepis	5	542–615	310–263
Pseudemys heiroglyphica	5	667–771	310–340
Pseudemys elegans	5	833–880	215–245
Chrysemys picta	5	750–835	210–220

Family GNATHOSTOMIDAE Railliet, 1895

Subfamily SPIROXYINAE Baylis and Lane, 1920

Genus SPIROXYS Schneider, 1866

At present three species of this genus are known to parasitize North American reptiles. These are *Spiroxys constricta* (Leidy), *S. contorta* (Rudolphi), and *S. amydae* Cobb. Furthermore, Walton (1927) states that *S. contorta* (Leidy) is not synonymous with *S. contorta* (Rudolphi), but Leidy's description seems to me to be too inadequate to warrant any definite conclusion on this point. Two of these are represented in my collection.

SPIROXYS CONTORTA (Rudolphi, 1819)

Walton (1927) reports finding representatives of this species in the existing Leidy collection. The specimens that he refers to this species were taken from the stomach of *Chrysemys picta.* I have taken a *Spiroxys*, which I tentatively refer to this species, from *Pseudemys elegans* and *Deirochelys reticularia* at Houston, Tex., and from *Sternotherus odoratus* at Huntsville, Tex. These worms agree very closely with the description of *S. contorta* (Rudolphi) given by Baylis and Lane (1920), except that they all possess a thickened, cuticular plate at the base of the lips on both the dorsal and ventral aspects. The cephalic margin of each plate bears three protuberances, which closely resemble papillae when the worm is viewed from the lateral aspect.

SPIROXYS AMYDAE Cobb, 1928

In spite of one important difference between my material and the original description of this species a number of parasites from the stomach of *Amyda ferox* are referred to it. Cobb (1928) states that there are only four teeth on each lip ("eight odontia in the pharynx"), while all my material plainly shows six teeth on each lip. But since Cobb has stated that his material was both immature and poorly preserved, and since both lots of material are from the same host, it seems probable that this difference is due to the condition of the type material.

Family TRICHINELLIDAE Stiles and Crane, 1910

Subfamily Trichurinae Ransom, 1911

Genus CAPILLARIA Zeder, 1800

This large and cosmopolitan genus has species parasitic in all the principle vertebrate groups, but in North American reptiles and amphibians only a single form, *C. recurva* from the American crocodile, has been reported. The following account adds two new species:

CAPILLARIA SERPENTINA, new species

Plate 5, Figures 9, 10

Specific diagnosis.—Capillaria: A slender, white worm, with an unstriated cuticula. The females are 12 to 14 mm long and 88μ to 103μ wide (no males were found). The esophagus is 4 or 5 mm long and runs for the greater part of its length through the usual row of circular cells. These cells are peculiar in that some are clear and others are crowded with many fine granules. The clear and granulated cells occur in alternating groups composed of two to five cells each. The anterior 0.5 to 0.6 mm of the esophagus is not encircled by cells. Presumably the nerve ring occurs in this region, but it could not be located, even with the use of an oil immersion lens. The intestine narrows rather suddenly at the beginning of the rectum, which is about 0.5 mm long. The anus is terminal and opens between two liplike protuberances, of which the ventral one is the smaller.

The genital system is of the usual type for the genus, with the vulva a short distance posterior to the posterior end of the esophagus. Only the eggs call for additional comment. They have two shells, the outer of which seems to be membranous and somewhat wrinkled. The inner one, which is much heavier, contains the usual plug in the end and seems to be slightly constricted at the middle. Both

of the egg coverings are colorless. The eggs measure 67μ to 72μ by 25μ to 34μ.

Host.—*Chelydra serpentina.*

Habitat.—Rectum.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 31709.

Remarks.—The foregoing description is based on two female specimens taken from the common snapping turtle. It seems to be remarkably similar to *Capillaria recurva* Solger, 1877, from the American crocodile. Both parasites are from reptilian hosts that inhabit fresh waters, but differences appear that make specific identity seem unlikely. *C. chelydrae* is only one-fifth as large and has a colorless intestine and egg covering, whereas in *C. recurva* the intestine is yellowish to dark brown and the eggs are also colored. Furthermore, Solger does not mention any peculiar mottling of the esophagus.

CAPILLARIA HETERODONTIS, new species

PLATE 5, FIGURES 11–13

Specific diagnosis.—*Capillaria:* A very slender, white nematode, with a smooth cuticula. The length of the male varies from 16.5 to 22.5 mm, and the maximum width from 45μ to 80μ. The esophagus is 7 to 11.5 mm long and does not show any very exact correlation with the total length. The posterior end bears a small bursalike expansion of the cuticula, which is supported by a short sharp tail on the dorsal side. The spicule is 2.55 to 3.25 mm long and blunt at the tip. The spicule sheath is without spines, and therefore this worm belongs to the subgenus *Capillaria* (Zeder) Travassos.

Length of the female varies from 24 to 26 mm, the width from 100μ to 115μ. The esophagus measures from 7.4 to 8.4 mm in length. The anus is subterminal, and the body ends bluntly. A rectum 0.35 to 0.8 mm long shows plainly. The vulva is 0.12 to 0.18 mm posterior to the end of the esophagus. The eggs are typical for the genus and seem to be inclosed in two shells with a plug at each end. The outer shell is thin but smooth. They measure 45μ to 55μ long by 25μ to 30μ wide.

Host.—*Heterodon contortrix.*

Habitat.—Rectum.

Locality.—Houston, Tex.

Type specimen.—U.S.N.M. Helm. Coll. No. 31710.

Remarks.—This species is easily distinguished from the other two species of *Capillaria* from North American reptiles by its size and by the shape of the caudal end of the female. The males of the other two species are unknown.

Class ACANTHOCEPHALA

Family NEOECHINORHYNCHIDAE Ward, 1917

Genus NEOECHINORHYNCHUS Stiles and Hassall, 1905

This genus is represented in North America by a number of species that are parasitic in fishes and turtles. There appears to be only one member of the genus parasitic in North American reptiles.

NEOECHINORHYNCHUS EMYDIS (Leidy, 1852)

This common parasite of terrapins has been encountered several times in the intestine of *Pseudemys elegans*. Frequently these worms were so numerous as to fill the lumen of the undistended intestine.

TABLE 3.—*Parasites of Amphibia and Reptilia included in this paper, listed systematically by hosts*

Host	Number examined	Parasite	Per cent infested
AMPHIBIA:			
Triturus meridionalis	8	*Cosmocercoides dukae*	62.5
		Brachycoelium meridionalis	37.5
		Mesocoelium americanum	12.5
		Manodistomum occultum	12.5
Ambystoma microstomum	4	*Cosmocercoides dukae*	25
		Brachycoelium daviesi	25
Ambystoma talpoideum	4	*Cosmocercoides dukae*	25
Siren lacertina	1	Negative	----------
Bufo terrestris	2	*Cosmocercoides dukae*	100
		Oswaldocruzia pipiens	50
Bufo valliceps	49	*Cosmocercoides dukae*	77+
		Oswaldocruzia pipiens	4+
Acris gryllus	32	*Cylindrotaenia americana*	16−
		Thubunaea leiolopismae (?)	6+
Pseudacris triseriata	26	*Cosmocercoides dukae*	62−
		Cylindrotaenia americana	7+
		Brachycoelium daviesi	7+
		Megalodiscus temperatus	7+
Hyla cinerea	4	*Oswaldocruzia pipiens*	25
		Brachycoelium daviesi	25
		Megalodiscus temperatus	25
Hyla squirella	11	*Cosmocercoides dukae*	18+
		Cylindrotaenia americana	9+
Hyla versicolor	1	Negative	----------
Rana areolata	8	*Megalodiscus temperatus*	37.5
		Cosmocercoides dukae	25
Rana catesbeiana	20	*Falcaustra catesbeianae*	50
		Gorgodera amplicava	35
		Haematoloechus floedae	20
		Megalodiscus temperatus	15
		Rhabdias ranae	15
		Glypthelmins subtropica	10
		Cosmocercoides dukae	5
		Proteocephalus magnus	5
Rana clamitans	5	*Megalodiscus temperatus*	80
		Cosmocercoides dukae	40
		Haematoloechus floedae	20
		Proteocephalus magnus	20
Rana palustris	1	*Oswaldocruzia pipiens*	100
		Cosmocercoides dukae	100
Rana sphenocephala	27	*Megalodiscus temperatus*	37+
		Cosmocercoides dukae	37+
		Rhabdias ranae	29+
		Brachycoelium hospitale	22+
		Oswaldocruzia pipiens	18+
		Megalodiscus americanus	4−
		Haematoloechus uniplexus	4−
		Glypthelmins subtropica	4−
Gastrophryne areolata	6	*Cosmocercoides dukae*	66⅔
REPTILIA:			
Anolis carolinensis	30	*Oochoristica anolis*	3+
		Proteocephalus sp	3+
Sceloporus undulatus	3	*Oswaldocruzia pipiens*	33+
Phrynosoma cornutum	7	*Diochetos phrynosomatis*	57+
		Physaloptera phrynosmoma	43−
Ophisaurus ventralis	4	*Cosmocercoides dukae*	25
Cnemidophorus sexlineatus	4	*Pharyngodon warneri*	50
Leiolopisma laterale	111	*Cylindrotaenia americana*	37−
		Brachycoelium daviesi	23+
		Thubunaea leiolopismae	20−
		Mesocoelium americanum	5−
		Oswaldocruzia pipiens	5−
		Physaloptera squamatae	4−
		Cosmocercoides dukae	4−
		Cysticercus sp	2−
Eumeces fasciatus	9	*Oswaldocruzia pipiens*	22+
		Oochoristica eumecis	11+
		Mesocoelium americanum	11+
		Cysticercus sp	11+
		Cosmocercoides dukae	44+
Eumeces septentrionalis	1	Negative	----------

TABLE 3.—*Parasites of Amphibia and Reptilia included in this paper, listed systematically by hosts*—Continued

Host	Number examined	Parasite	Per cent infested
REPTILIA—Continued			
Farancia abacura	2	*Stomatrema pusilla*	50
		Oochoristica americana	50
		Proteocephalus faranciae	50
		Kalicephalus agkistrodontis	50
Heterodon contortrix	4	*Cosmocercoides dukae*	50
		Lechriorchis validus	25
		Renifer texanus	25
		Rhabdias vellardi	25
		Capillaria heterodontis	25
Opheodrys aestivus	7	*Brachycoelium* sp.	14+
Coluber constrictor flaviventris	2	*Kalicephalus agkistrodontis flagellus*	50
		Ophidascaris sp.	50
		Polydelphis sp.	50
		Kalicephalus rectiphilus	50
Coluber flagellum	2	*Kalicephalus agkistrodontis flagellus*	50
Elaphe obsoleta lindheimerii	1	*Oochoristica elaphis*	100
Pituophis sayi	1	*Kalicephalus agkistrodontis*	100
Lampropeltis calligaster	3	Negative	
Lampropeltis getulus holbrooki	3	*Kalicephalus agkistrodontis*	33.3
		Lechriorchis validus	33.3
Natrix rhombifera	2	*Oochoristica natricis*	50
		Kalicephalus agkistrodontis	50
Natrix sipedon fasciata	6	*Renifer aniarum*	50
		Dasymetra conferta	33+
		Kalicephalus agkistrodontis	17−
Storeria dekayi	6	*Cosmocercoides dukae*	83+
		Mesocoelium americanum	33+
		Brachycoelium storeriae	17−
		Rhabdias vellardi	17−
Potamophis striatulus	7	*Rhabdias vellardi*	43−
Thamnophis proximus	7	*Kalicephalus agkistrodontis*	57+
		Rhabdias vellardi	43−
Micrurus fulvius	3	*Kalicephalus agkistrodontis*	33+
		Cosmocercoides dukae	33+
Agkistrodon mokasen	14	*Kalicephalus agkistrodontis*	100
		Renifer kansensis	14
		Physaloptera squamatae	7
Sistrurus miliarius	2	*Renifer kansensis*	50
Sternotherus carinatus	2	*Cercorchis bairdi*	50
		Spiroxys contorta	50
Kinosternon subrubrum hippocrepis	16	*Heronimus chelydrae*	31+
		Camallanus trispinosus	25
		Polystoma hassalli	12.5
Chelydra serpentina	9	*Falcaustra chelydrae*	100
		Camallanus trispinosus	100
		Polystoma hassalli	33+
		Auridistomum chelydrae	22+
		Henotosoma chelydrae	14+
		Capillaria serpentina	14+
Terrapene carolina triunguis	14	*Falcaustra affine*	92+
		Cruzia testudinis	92+
		Atractis carolinae	92+
		Cosmocercoides dukae	50
		Oswaldocruzia pipiens	15+
		Polystoma terrapenis	8−
Terrapene ornata	2	*Cosmocercoides dukae*	50
		Oswaldocruzia pipiens	50
Pseudemys elegans	16	*Camallanus trispinosus*	87.5
		Neoechinorhynchus emydis	69−
		Polystoma megacotyle	44−
		Spiroxys contorta	25
		Polystoma orbiculare	19−
		Falcaustra procera	19−
		Cercorchis texanus	19−
		Cercorchis robustus	12.5
		Heronimus chelydrae	6+
		Protenes chapmani	6+
Deirochelys reticularia	1	*Camallanus trispinosus*	100
		Spiroxys contorta	100
Amyda ferox	4	*Spiroxys amydae*	75
		Falcaustra chelydrae	50
		Camallanus trispinosus	50

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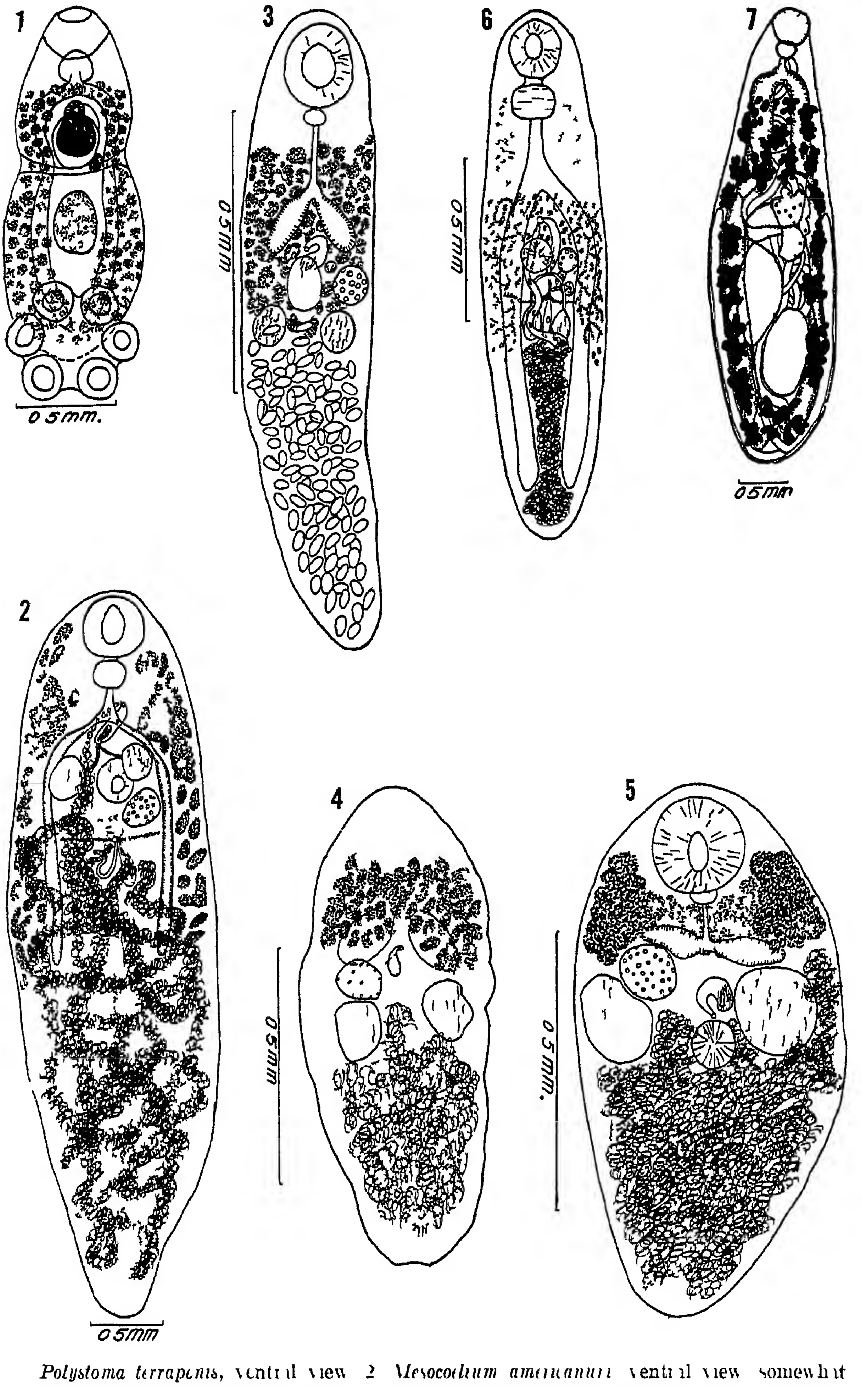
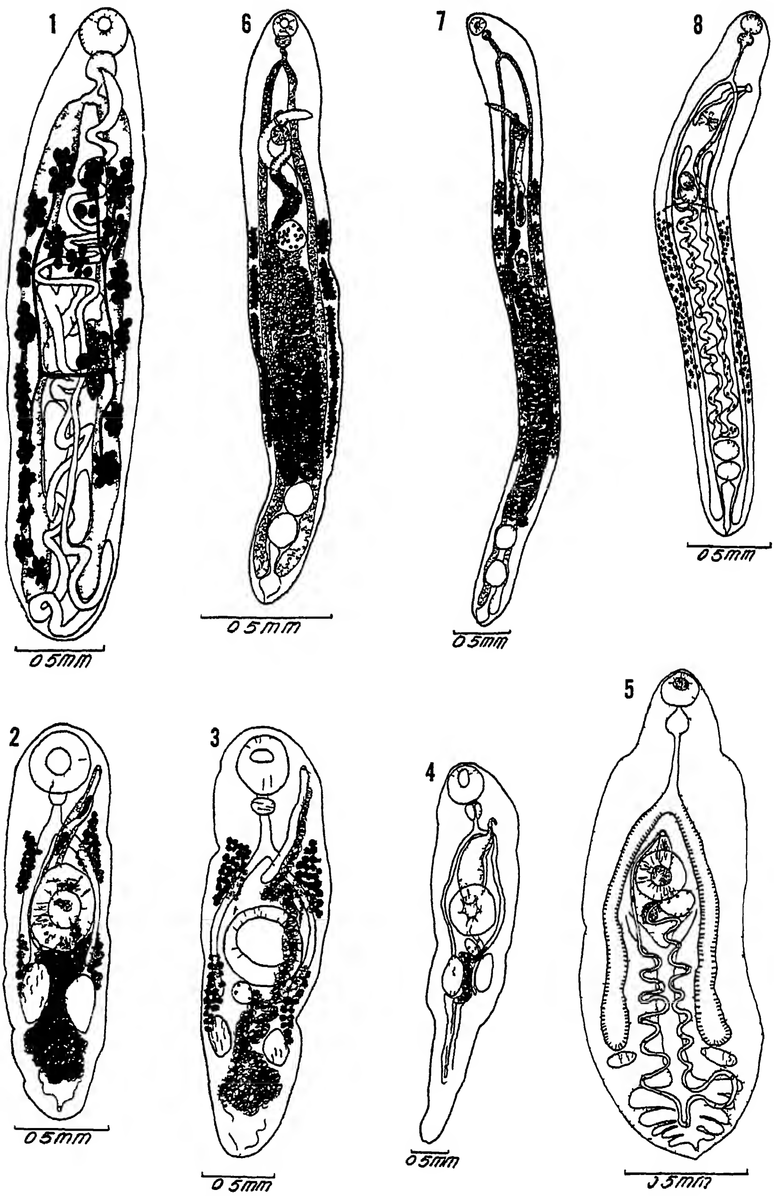
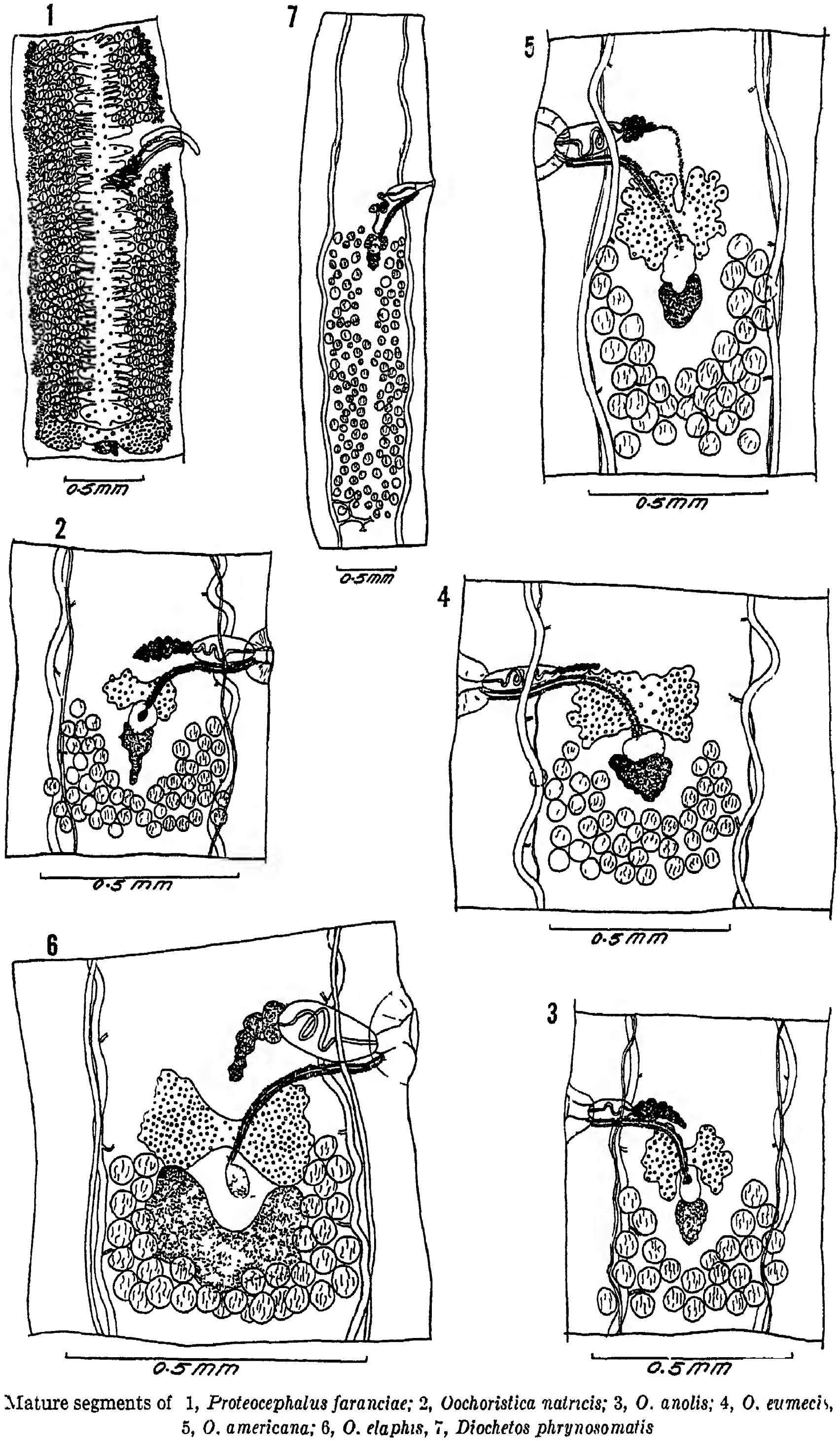


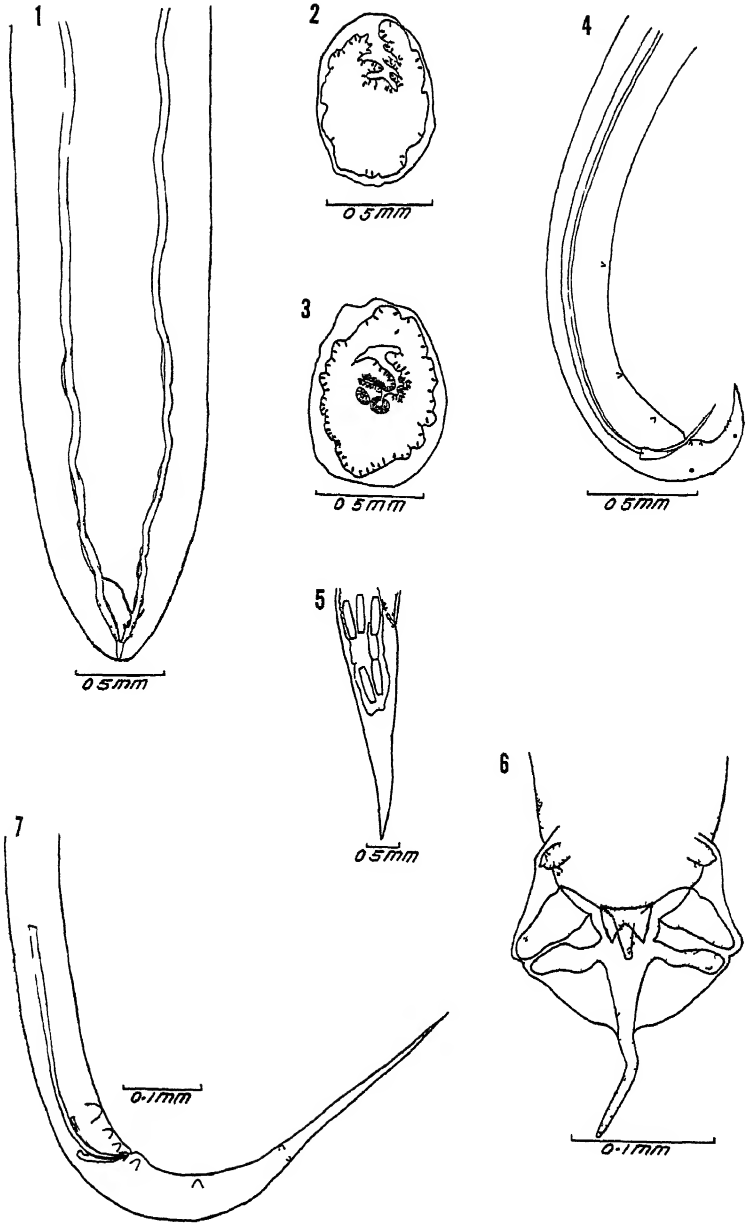
Polystoma terrapenis, ventral view 2 *Mesocoelium americanum* ventral view somewhat flattened 3 *Brachycoelium storeriae* ventral view 4 *B meridionalis* dorsal view 5 *B daviesi*, ventral view 6 *Glypthelmins subtropica* ventral view with vitellaria drawn in 7 *Haematoloechus floedae* dorsal view



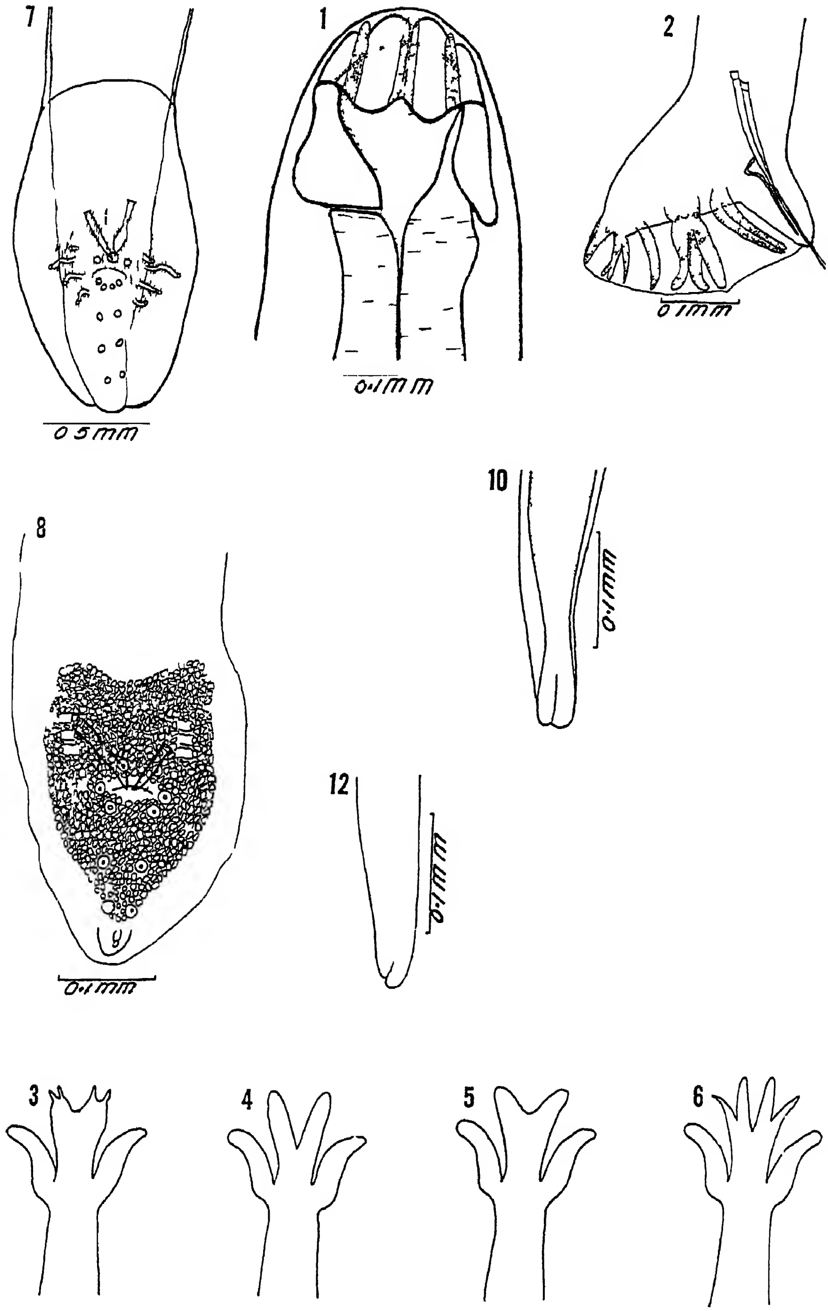
1, *Haematoloechus uniplexus*, ventral view with vitellaria drawn in. 2, *Renifer texanus*, ventral view. 3, *R. anarum* (Leidy), ventral view. 4, *Lechriorchis validus*, ventral view. 5, *Manodistomum occultum*, ventral view. 6, *Cercorchis texanus*, ventral view. 7, *C. bairdi*, ventral view. 8, *Protenes chapmani*, dorsal view.



Mature segments of 1, *Proteocephalus faranciae;* 2, *Oochoristica natricis;* 3, *O. anolis;* 4, *O. eumecis,* 5, *O. americana;* 6, *O. elaphis,* 7, *Diochetos phrynosomatis*



1 *Diochetos phrynosomatis* a reconstruction of the excretory system of a terminal segment 2 oblique section through a *Cysticercus* sp 3 oblique section through the same *Cysticercus* sp but showing the suckers 4 *Falcaustra chelydrae* posterior end of male but showing only a portion of the spicule 5 *Pharyngodon warneri* caudal end of female 6 *P warneri* caudal end of male 7 *Atractis carolinae* caudal end of male



1, *Kalicephalus agkistrodontis*, lateral view of cephalic extremity. 2, *K. rectiphilus*, bursa. 3, 4, *Oswaldocruzia pipiens*, dorsal ray pattern of specimens from *Leiolopisma laterale*. 6, *O. pipiens*, dorsal ray pattern of specimens from *Terrapene carolina triunguis*. 7, *Physaloptera squamatae*, caudal extremity of male. 8, *Thubunaea leiolopismae*. 9, *Capillaria serpentina*, vulvar region of female. 10, *C. serpentina*, caudal extremity of female. 11, *C. heterodontis*, caudal extremity of male. 12, *C. heterodontis*, caudal extremity of female. 13, *C. heterodontis*, eggs.

ON A NEWLY MOUNTED SKELETON OF DIPLODOCUS IN THE UNITED STATES NATIONAL MUSEUM

BY

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INTRODUCTION

Eight years after the exhumation from its resting place in the Dinosaur National Monument in northeastern Utah an articulated skeleton of *Diplodocus* is now on display in the United States National Museum.

The quarrying of these bones was a slow and tedious process, involving the skill of both the miner and the stone cutter, but the magnitude of the task, by a small force, of preparing one of these huge skeletons for public exhibition can be fully appreciated only by those who have passed through such an experience. The extraction of the bones, especially the vertebrae, from huge blocks of refractory sandstone, the restoration of missing parts, and the shaping of the necessary irons to support the skeleton are all arduous, time-consuming operations. It is therefore not surprising that so much time has been required for the completion of this work.

The skeleton has been given an upright quadrupedal pose, with the head uplifted as if scanning its surroundings. It is thought that the entire ensemble portrays this giant reptile more accurately than any previous mount. The missing bones were, for the most part, replaced by casts from the *Diplodocus* specimen in the Carnegie Museum in Pittsburgh, all of the replaced parts being colored to harmonize with the actual bones but with sufficient difference as at once to be distinguished from the originals.

The bones were prepared by Norman H. Boss, Thomas J. Horne, and John M. Barrett; the mounting was done by Messrs. Boss and Horne, but I alone am responsible for any anatomical inaccuracies that may be detected in the reconstruction.

The method of mounting adopted is, with some modifications, that first devised by Arthur Coggeshall in mounting the skeleton of *Diplodocus carnegii* in the Carnegie Museum at Pittsburgh—that is, the vertebral column is supported by a linear series of steel cast-

ings, which conform to the shape of the underside of the vertebrae, these in turn being supported by a number of pipe uprights securely anchored in the base. The vertebral supports were cast in 6-foot lengths and after being placed in final position were welded together into one continuous piece. The limbs and other bones are supported by half-round irons with the flat side fitted to the inequalities of the bones. All the ironwork is camouflaged to the variegated color of the specimen so as to render the supporting work as inconspicuous as possible.

The present specimen is a fully adult animal and, except for the missing portions, is an excellent example of its kind.

COLLECTING THE SPECIMEN IN THE DINOSAUR NATIONAL MONUMENT

In the Uinta Basin in northeastern Utah, near Jensen, Uinta County, an 80-acre tract of land has been set aside as a part of the national park system under the name of Dinosaur National Monument. This reservation, as may be inferred, contains an extensive and important deposit of dinosaurian fossils.

The history of the Dinosaur National Monument had its beginning in 1909 with the discovery of dinosaurian fossils by Earl Douglass, of the Carnegie Museum. During the first six years of work there such an abundance of well-preserved specimens was found that in 1915, at the instigation of Dr. W. J. Holland, then director of the Carnegie Museum, the Secretary of the Interior withdrew this area from the public domain as a national monument in order to conserve this important deposit of fossils. Governmental permission to continue their excavations, however, was granted from year to year up to the close of 1922, when the quarry was abandoned. In the 13 consecutive years that operations were carried on there by the Carnegie Museum, a great mass of material, some 300 tons in all, I am told, was collected. In those collections were many articulated skeletons of both large and small dinosaurs, and especially important was the recovery of a considerable series of well-preserved skulls, the rarest and most sought for part of the dinosaurian skeleton. The great diversity of forms represented, together with their unusually perfect and excellent preservation, marks this as the most remarkable deposit of Morrison fossils ever discovered.

The principal fossil-bearing horizon is a heavy, greenish, conglomeratic, cross-bedded sandstone that occurs in the upper half of the Morrison formation. The Morrison in this section, according to measurements made by Dr. J. B. Reeside, jr.,[1] has a total thickness of 795 feet, made up of the usual alternating beds of shale and sand-

[1] U. S. Geol. Surv. Prof. Paper 132C, pp. 44–45, 1923.

stone. The whole geological section, beginning with the Triassic and extending upward successively through the marine Sundance, Beckwith (Morrison), Dakota, Mowry shales, and Frontier formation, is steeply tilted with a strong dip to the south. The dip reaches an angle of 60° or more above the horizontal.

Although fossil bones have been found at several other levels, nowhere are they so abundant or so well preserved as in the sandstones previously mentioned. The outcropping ledge formed by this layer of fossil-bearing sandstone, which weathers brown, can be easily traced for a mile or more both east and west from the quarry, and fossil bones are evident everywhere.

In the quarry there is a veritable Noah's Ark of the animals of this period. Here was found the largest of the giant sauropodous dinosaurs closely mingled with remains of the smaller but powerful carnivorous forms and those of the slow and heavy-armored *Stegosaurus*, as well as the lightest and most birdlike dinosaurs. Intermingled with these are occasionally found turtle shells, crocodile remains, and fossil wood.

Some of the skeletons are essentially complete, with most of the bones properly articulated, but more frequently only a third or a fourth of a skeleton remains, such as a complete tail, a section of the back, a neck, or a complete limb or foot. Some few of the bones are badly crushed, but on the whole they are quite free from distortion.

The character of the sediments appears to represent the area of an old river bar, which in its shallow waters arrested the more or less decomposed carcasses collected from many points upstream as they drifted down toward it. Thus were brought together the animals of a whole region—a fact which vastly enhances the interest of this deposit. The final part of the story necessitates a rapid covering of the stranded carcasses by sand and other river sediments in order that the bones of the skeletons should become fixed in their relative positions before decomposition of the ligamentary attachments allowed them to shift out of position. That many of the larger skeletons were not completely covered immediately is shown by the fact that the bones of the lower side remain undisturbed while those of the upper or exposed side often show much displacement of parts. That this scattering of the bones was due to current action is indicated by the fact that wherever shifting has taken place they will invariably be found to the eastward of the main portion of the skeleton. In other words, the direction of the current was from the west toward the east. Current action is further indicated by the character of the sediments in which the bones are embedded; that is, by the strong cross-bedding and the assorting of the fine and coarse materials of which the sandstone is composed.

In their final excavating work before abandoning operations, the Carnegie Museum collectors uncovered two partially articulated sauropod skeletons. When these facts were communicated to the officials of the Smithsonian Institution, plans were immediately made to take up the work in order to secure a mountable skeleton of one of these huge reptiles for the national collections. It was my privilege to be placed in charge of this expedition.

I arrived at the quarry about the middle of May, 1923, and a preliminary survey showed that of the two skeletons partly worked out in relief (see fig. 1) the one bearing the field designation No. 355, although lacking the neck, appeared to offer the best basis for an exhibition skeleton. At the time it appeared to be beautifully supplemented by a second specimen with the cervicals present and of approximately the same size, but later, after preparation in the laboratory, this neck was found to pertain to the genus *Barosaurus* and therefore was no longer available for our purposes.

Regular work in the quarry was begun during the latter part of May and proceeded continuously up to August 8, in which time all of No. 355 and the parts needed of the second individual, were collected and packed for shipment. The three men employed—J. T. Kay, E. M. York, and Golden York—all with experience in this kind of collecting, together with the skillful assistance of N. H. Boss from the National Museum, were largely responsible for the successful outcome of the operations. Difficulty was encountered in handling by primitive methods and in the subsequent arduous work of boxing and transporting the immense blocks of stone inclosing the bones. The largest block quarried containing the sacrum with attached hip bones weighed nearly 6,000 pounds when ready for shipment. The transportation of the boxes to the railroad involved a haul by teams of 150 miles across country and over a range of mountains 9,000 feet above sea level. However, 34 large boxes, having a combined weight of 25 tons, were safely transported to the Museum.

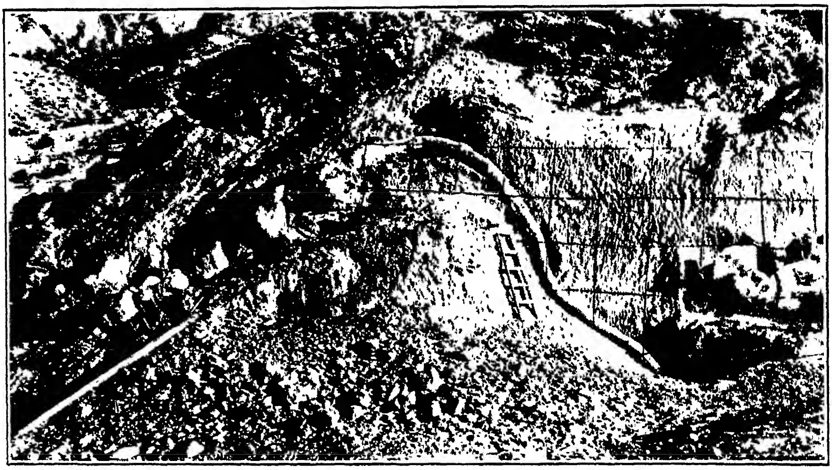
Position of the skeleton in the ground.—The specimen lay on its left side. The vertebral column was articulated beginning with the fragmentary centrum of the fifteenth cervical back to and including the fifth caudal. The cervical end of the column was protruding from the outcropping ledge of rock, and if the anterior cervical vertebrae were originally present, they had long since been eroded away and destroyed. The remaining part of the tail had been carried to the eastward and lay extended at right angles to the thoracic part of the skeleton, as clearly shown in the quarry diagram. (See fig. 1.) In all, 32 caudal vertebrae were recovered, all being in articulated sequence except for the dislocation between the fifth and

DINOSAUR NATIONAL MONUMENT

The caudal vertebrae of *Apatosaurus* in the middle foreground was the initial discovery that led to the development of this great quarry In uncovering this skeleton other specimens were found, and so it continued to develop during the entire 15 years that work was carried on there From a photograph by Earl Douglass

DINOSAUR NATIONAL MONUMENT

Quarry viewed from the west end of the Carnegie Museum excavation The fossil bearing layer has been largely removed from the uptilted rocks on the left of the picture The track was used for a small mine car on which the debris was removed to the dump From a photograph by Earl Douglass



DINOSAUR NATIONAL MONUMENT

A large dinosaur skeleton in process of exhumation by Carnegie Museum collectors. The squares outlined on the rock face are for use in accurately plotting the fossils on a quarry map. From a photograph by Earl Douglass.

DINOSAUR NATIONAL MONUMENT QUARRY

Face of quarry showing a dinosaur skeleton partly uncovered. The large size of the bones is indicated by comparison with a man seated in the right foreground. From a photograph by Earl Douglass.

DINOSAUR NATIONAL MONUMENT QUARRY

Showing the method used in lowering large bones from the steeply inclined face of the quarry. From a photograph by Earl Douglass.

DINOSAUR NATIONAL MONUMENT QUARRY

Showing the method of removing large blocks of plaster incased bones from the quarry to a point accessible to wagons. From a photograph by Dr. K. C. Max.

The *Diplodocus* skeleton (U.S.N.M. No. 10865) as it was partly uncovered in the face of the quarry. The sacrum with attached ilia is to the left of the man, whose hand is resting on the left femur. The tibia may be seen extending directly downward from the knee joint; the fibula and the complete articulated foot were in correct relationship. At the right of the knee joint are the articulated pubes. The articulated caudal series may be seen at the man's feet. The ends of the articulated thoracic ribs of the left side are protruding from the rock. The articulated dorsal vertebrae extend upward from the sacrum to the top of the picture. On the extreme upper right border are the bones of the fore limbs, the right humerus being articulated with the radius and ulna

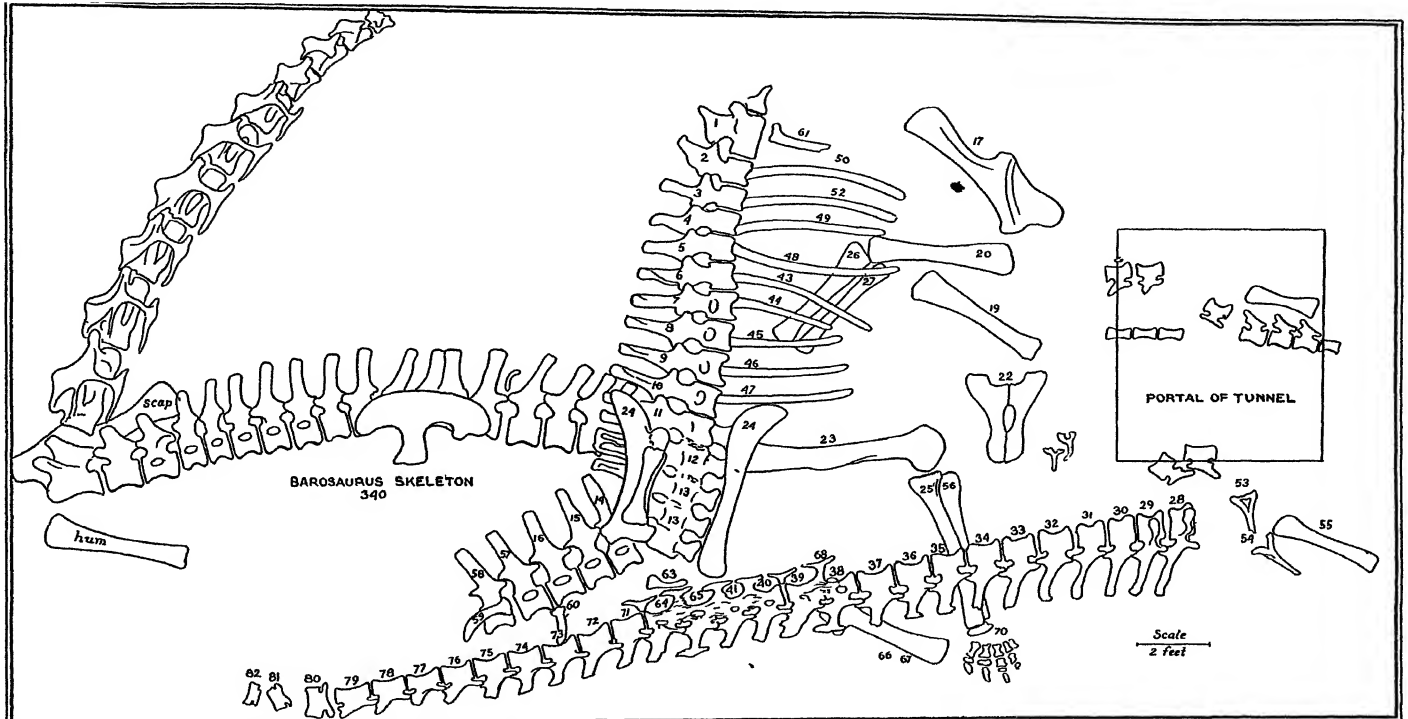


FIGURE 1.—Diagram or quarry map showing the relative positions of the bones of the *Diplodocus* skeleton as it was embedded in the sandstone. Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10, dorsals 1 to 10, respectively; 11, 12, and 13, sacral vertebrae; 14, 15, and 16, caudal vertebrae 1, 2, and 3; 17, right scapula and coracoid; 19, left humerus; 20, right humerus; 22, pubes; 23, left femur; 24, ilia; 25, left tibia; 26, right ulna; 27, right radius; 28, sixth caudal vertebra; 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, seventh to nineteenth caudal vertebrae; 43, 44, 45, 46, 47, sixth to tenth ribs of the left side; 48, fifth rib of left side; 49, fourth rib of left side; 50, third rib of left side; 52, second rib of left side; 53, fourth chevron; 55, left ulna; 56, left fibula; 57, fourth caudal vertebra; 58, fifth caudal vertebra; 59, chevron; 60, third chevron; 63, metatarsal; 64, twenty-first caudal vertebra; 65, twentieth caudal vertebra; 66, 67, ischia; 68, chevron; 70, left hind foot; 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, caudal vertebrae; 82, caudal vertebra not used in mounted skeleton

sixth mentioned above, and three distal ones displaced at the end. The thoracic ribs of the lower or left side, except the first, were all present and articulated with their respective vertebrae; those of the upper or right side, except one found out of position, were all missing. The left hind leg and foot remained articulated but stretched out in a sprawling position, as shown in Plate 4. The pubes, ischia, bones of the pectoral girdle, and fore-limb bones were found to the east of the main portion of the skeleton. The detailed list of the skeletal parts found is as follows: 10 dorsal vertebrae; 5 sacral vertebrae; 32 caudal vertebrae; 9 ribs (left), 1 (right); both ilia; pubes and ischia; right scapula and coracoid; both humeri; both ulnae; one radius; left hind leg and foot complete; 18 chevron bones.

In the accompanying diagram (fig. 1) made at the time of collecting the specimen the bones of the skeleton are represented in the position in which they were found embedded in the sandstone.

The destructive work of wind, water, and frost in breaking down fossil bones exposed to their action is well illustrated by certain elements of this skeleton.

Collectors from the Carnegie Museum had partially worked out the skeleton from the conglomeratic sandstone in which it was embedded, as shown in Plate 4. The bones thus uncovered remained exposed to the action of the elements for nearly two years before recovery, and in that time many of them were considerably damaged. When first uncovered the preservation was almost perfect and the bones were dark colored, but with exposure they whitened and became much checked and broken, in several instances considerable parts being lost. While some of the missing portions may perhaps be attributed to vandalism, much of the loss is directly due to erosive disintegration, that is, breaking up into such small particles made it no longer possible to preserve the parts affected. On the other hand, undisturbed bones were found to be dark in color and perfectly preserved. This is an interesting example of the rapidity of the disintegration of fully mineralized bones when exposed to the elements.

The vertebrate fauna of the Dinosaur National Monument as known at the present time is as follows:

Dinosauria:
- Saurischia:
  - *Apatosaurus louisae* Holland.
  - *Barosaurus* sp.
  - *Camarasaurus lentus* (Marsh).
  - *Diplodocus* sp.
  - *Pleurocoelus* sp.
  - *Uintasaurus douglassi* Holland.
  - *Antrodemus* (*Allosaurus*) sp.

Ornithischia:
Camptosaurus medius Marsh.
Dryosaurus altus Marsh.
Laosaurus gracilis Marsh.
Stegosaurus sp.
Crocodilomorphi:
Goniopholis sp.
Chelonia:
Glyptops utahensis Gilmore.
Phytosauromorphi:
Hoplosuchus kayi Gilmore.

That this preliminary list will be greatly augmented by the study of material already in hand, there is no doubt.

THE SPECIES OF DIPLODOCUS

Four species of *Diplodocus* have been proposed. Named in chronological order these are: *Diplodocus longus* Marsh, *D. lacustris* Marsh, *D. carnegii* Hatcher, and *D. hayi* Holland.

Diplodocus longus, the genotype, was established in 1878[2] on caudal vertebrae from the midcaudal region. Hatcher[3] has shown that a hind limb and foot mentioned in the original description pertain to the genus *Apatosaurus* (*Brontosaurus*) and can therefore no longer be considered diagnostic of *Diplodocus*. The type specimen is from the Morrison formation near Canon City, Colo.

In 1884 Marsh[4] described *D. lacustris* from the same formation near Morrison, Colo. In the original description a maxillary, teeth, and lower jaws only are mentioned. This was distinguished from *D. longus* by its smaller size and "the much more slender jaws."

In 1901 Hatcher[5] added a third species, *D. carnegii*, based on a well-preserved skeleton, lacking the skull, from Sheep Creek, Albany County, Wyo.

In 1924 Dr. W. J. Holland[6] described *D. hayi* based on the posterior part of a cranium from Wyoming, chiefly distinguished by the absence of a pineal fontanelle in the parietal.

This brief review of the specimens upon which the four species of *Diplodocus* were based shows at once the impossibility of properly contrasting their essential specific differences, and the specific identification of the National Museum specimen is therefore rendered difficult, if not impossible, until there has been a thorough revision of the genus.

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[2] Marsh, O. C., Amer. Journ. Sci., vol. 16, p. 414, 1878.
[3] Hatcher, J. B, Mem. Carnegie Mus., vol. 1, p. 55, 1901.
[4] Marsh, O. C., Amer. Journ. Sci., vol. 27, p. 166, 1884.
[5] Hatcher, J. B., Mem. Carnegie Mus., vol. 1, p. 57, 1901.
[6] Holland, W. J., Mem. Carnegie Mus., vol. 9, p. 399, 1924.

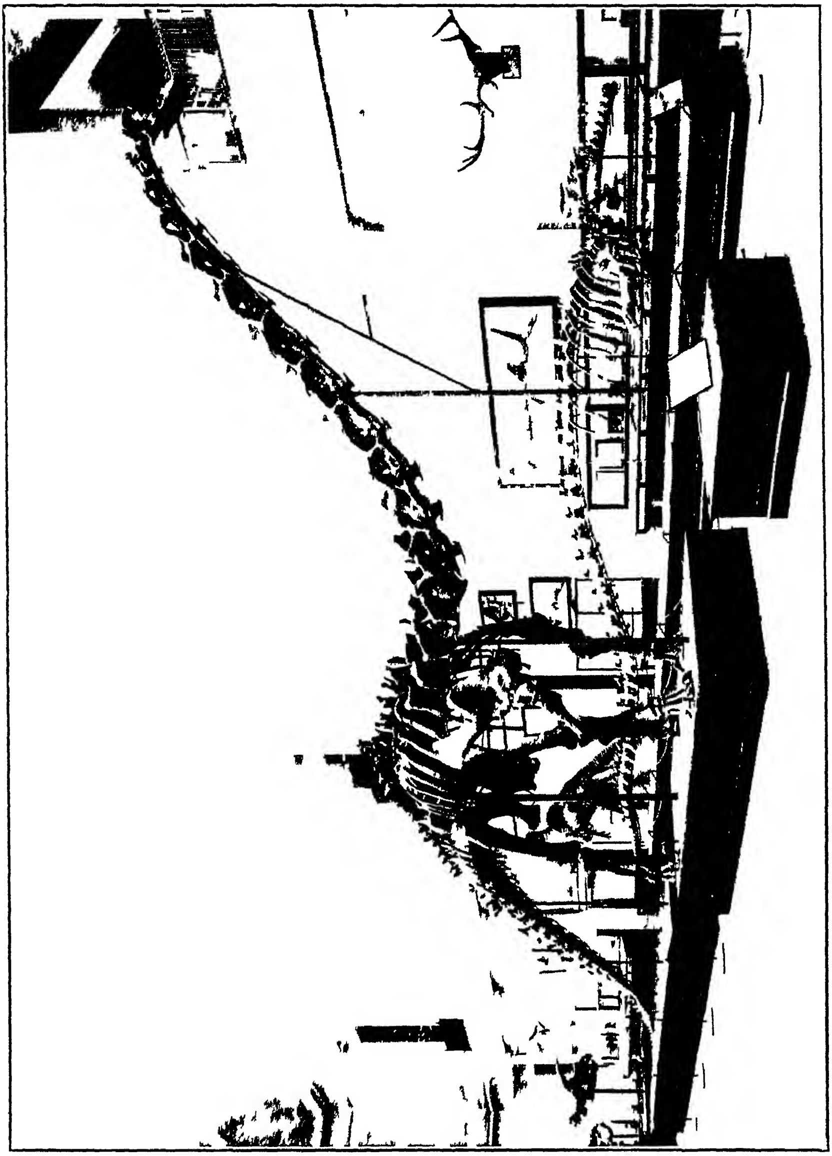
In establishing *D. carnegii*, Hatcher used the more backward inclination of the caudal spines as one of the principal characters for distinguishing it from *D. longus*. The unstableness of this as a distinguishing characteristic is indicated in the present specimen where many of the spinous processes are as much inclined as in *D. carnegii*, while others stand as erect as those of *D. longus*, and is therefore not to be depended upon for distinguishing these two species. Attention is also directed to the fact that since the cervical vertebra originally regarded by Marsh as pertaining to *D. longus* has been shown by Hatcher to pertain to *Apatosaurus* (*Brontosaurus*), the disparity in size of the *D. carnegii* cervical ribs no longer obtains. Thus the species *D. carnegii* is now without specific characterization. Whether the species can be satisfactorily maintained, only a restudy of the original materials can determine. The lack of the skull in the present specimen renders impossible necessary comparisons with the type materials of either *D. lacustris* or *D. hayi*. Under present conditions, therefore, it is practically impossible to identify the specimen under discussion, but in order to avoid further complications in the synonomy I shall tentatively refer it to the species *longus* until a thorough study of the type materials shall disclose the standing of the four species already established.

POSE OF THE SKELETON

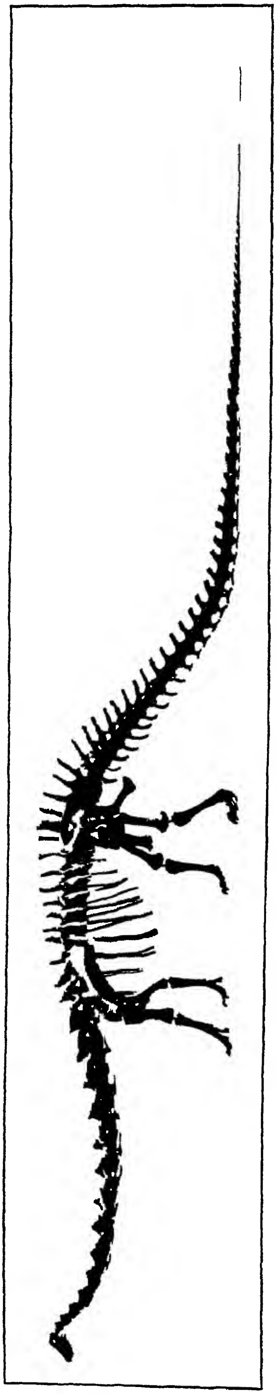
Probably no other extinct animal has been subjected to more intensive study or searching criticism as to the proper pose of a skeleton than has *Diplodocus*. Eminent authorities are divided in their opinion as to whether this animal walked about in a normal upright quadrupedal position or habitually assumed a more prone attitude like the crocodile. Those contending for the first mentioned pose are Hatcher,[7] Osborn,[8] Holland,[9] Abel,[10] and Matthew,[11] while those for the latter are Tornier,[12] Hay,[13] and Hutchinson.[14]

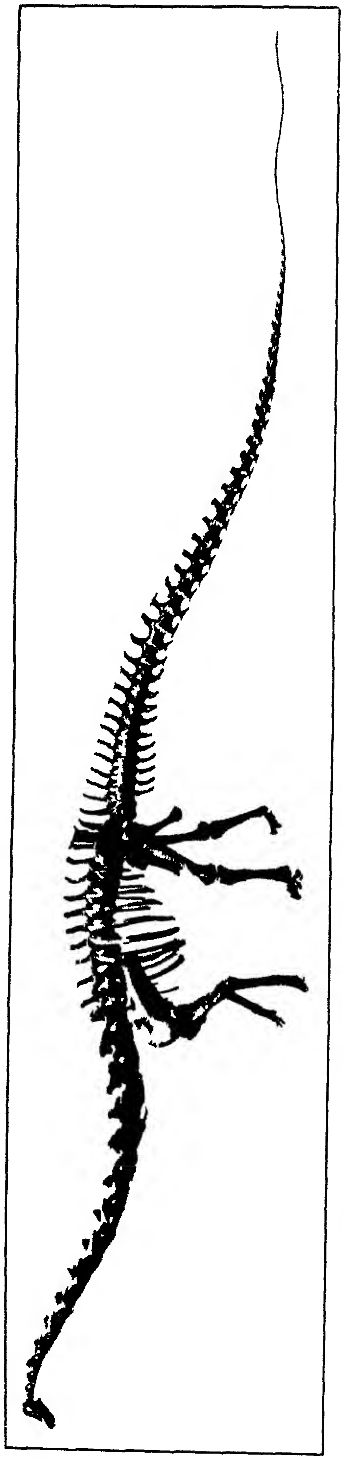
I have in the present mount adopted the quadrupedal pose, and my experience in supervising the articulation of the skeleton has fully convinced me that the crocodilian attitude for *Diplodocus* involves anatomical impossibilities. Nevertheless, the actual articulation of the bones has brought out some points in the anatomy of *Diplodocus* that otherwise would have passed unnoticed. I refer especially to

[7] Mem. Carnegie Mus., vol. 1, no. 1, pp. 57–59, 1901.
[8] Mem. Amer. Mus. Nat. Hist., vol. 1, pp. 191–214, 1899.
[9] Amer. Nat., vol. 44, pp 259–283, 1910.
[10] Abh. k. k. zool-bot. Ges. in Wien, vol. 5, pp. 1–60, 1909–10.
[11] Amer. Nat., vol. 44, pp. 547–560, 1910.
[12] Sitz.-Ber. Ges. Naturf. Freunde Berlin, 1909, pp. 193–209.
[13] Amer. Nat., vol. 42, pp. 672–681, 1908; Proc. Washington Acad. Sci., vol. 12, pp. 1–25, 1910.
[14] Geol. Mag. London, vol. 4, pp. 356–370, 1917.



Skeleton of *Diplodocus longus* Marsh (U. S. N. M. No. 10865) as exhibited in the hall of vertebrate paleontology in the United States





COMPARATIVE VIEWS OF THE MOUNTED SKELETONS OF DIPLODOCUS CARNEGII AND D LONGUS

Upper figure Mounted skeleton of *Diplodocus carnegii* in the Carnegie Museum Pittsburgh Pa Lower figure Mounted skeleton of *Diplodocus longus* in the United States National Museum Both views are from the left side and both are about 1/90 natural size

the upward curvature of the vertebral column both before and behind the sacral region. In previous restorations of *Diplodocus* the presacral region is depicted as extending nearly straight out from the sacrum, the caudals forming a rapidly drooping tail. This idea was carried out in the mounting of the original skeleton of *D. carnegii* and its many replicas distributed over the world. The present specimen shows an error in both of these respects. The articulated presacrals in our specimen have a decided upward arcuation of the column beginning with the vertebrae immediately in front of the sacrum. That this is a natural arrangement seems to be indicated by the peculiar character of the most posterior dorsals, which have the tall spinous processes strongly inclined forward of the vertical axis of the vertebrae as a whole. In other words, when the tenth dorsal vertebra is in position the lower half is inclined backward, which brings the forward leaning spine into a nearly vertical position and thus the spines are evenly spaced; whereas in both the Carnegie Museum and American Museum specimens there are wide gaps between the sacrodorsal and the first free dorsal in front of it. In the Carnegie specimen the spine was detached when found and in restoring it was placed in a vertical position. Similarly in the American Museum specimen the first free dorsal in front of the sacrum which lacked the centrum was restored with the spine in a vertical position. In both instances the wide gap between the tops of the spines resulted when the bones were articulated.

Forward of the mid-thoracic region the column starts the reverse curve downward; thus this part of the backbone has a more natural arched curvature than has previously been given it. This upward curve of the presacral region makes the mid dorsals the highest point above the ground, whereas in the *Diplodocus carnegii* specimen the sacral region is highest.

In so far as the pose of the tail is concerned, the Pittsburgh authorities now recognize the incorrectness of the *D. carnegii* specimen, and in the mounted skeleton of *Apatosaurus* in this same institution the tail is carried far out from the sacrum before beginning to droop toward the ground. This same result was attained by the articulation of the actual bones in the present skeleton, brought about by the decided V-shaped centrum of caudal 3, which is much shorter above than below, and Lull [15] found that the same condition obtains in *Camarasaurus* and *Brontosaurus*. The upward curvature of the tail in the sauropodous dinosaurs bears a striking resemblance to that of the large extant lizard *Varanus komodoensis*.

It would thus seem that all the Sauropoda are so constituted. The elevation of this part of the tail well outward above the posteriorly

[15] Amer. Journ. Sci., vol 19, pp. 1–5, 1930.

directed ischia gives plenty of room for the extrusion of the egg, a question raised by the late Dr. S. W. Williston upon viewing the rapidly drooping tail of *D. carnegii* for the first time.

The National Museum skeleton as restored has a greatest length between perpendiculars of 70 feet 2 inches, and in front of the hips the tops of the spinous processes of the vertebrae are 12 feet 5 inches above the ground. The head in the pose adopted is 14 feet 6 inches high, but it is clearly apparent that in life it could have been elevated still higher.

The skeleton of *D. carnegii* is said to be 84½ feet in length (probably measured over the curve of the backbone) and 14½ feet high at the hips. I am at a loss to explain the difference in height between the two skeletons, especially since the individual limb bones of the two specimens have practically the same linear dimensions. The difference in length may be accounted for by the slightly greater length of the individual vertebrae of *D. carnegii* and by the omission in the present skeleton of four caudal vertebrae as mentioned elsewhere.

NOTES ON THE DETAILED SKELETAL ANATOMY OF DIPLODOCUS

Since the skeletal parts of *Diplodocus* have been described in great detail by Marsh, Osborn, Hatcher, and Holland, it is now only necessary to call attention to certain anatomical details displayed for the first time by the specimen here described.

Dorsal vertebrae.—The complete dorsal series of 10 vertebrae was found in articulated sequence with the sacrum completely interlocked by their zygapophyses. This specimen thus positively confirms Hatcher's serial determination of the dorsals in *D. carnegii*, some of which were originally found displaced. Comparison of the dorsal vertebrae of the present specimen with the illustrations and descriptions [16] of these bones of *D. carnegii* shows them to be in accord in all important particulars, any differences being confined chiefly to the position and direction of the various buttressing laminae; but since no two vertebrae in the series are alike, and since great dissimilarities often exist on opposite sides of the same vertebra, the differences noted between the dorsals of these two specimens are not considered of much import.

Viewed antero-posteriorly the spines of the vertebrae of the posterior half of the column are relatively wider than in *D. carnegii*, on account of a widening of the lateral laminae. The tall simple spines of the posterior dorsals are succeeded anteriorly by emarginate spines at the apex that become progressively cleft deeper and deeper until in the anterior dorsals there are two distinct parallel

[16] Mem. Carnegie Mus., vol. 1, no. 1, 1901.

spines. The sixth vertebra is the first to show a decided cleft, but in the present specimen it is considerably shallower than in the homologous vertebra of the *D. carnegii* skeleton.

The relative position of the rib articulations, the size of the pleurocels, and the shape and extent of the transverse processes are all in accord with *D. carnegii.* The tenth dorsal is of interest in having the spine intact, the first specimen found showing its true relationship to the lower half of the vertebra. The spine is strongly inclined forward of the vertical axis of the vertebra as a whole. In other words, when the vertebra is placed in an articulated position the lower half is inclined backward (see fig. 2), which brings the forwardly inclined spine into a nearly vertical position. Especial mention is made of this feature for the reason that in previous restorations the tenth vertebral spine has been either restored or replaced in the vertical axis, and when articulated a faulty spacing of the spine top in relation to others of the series has resulted. This forward angulation in the present specimen brings about a fairly uniform spacing of the spines, as would be expected.

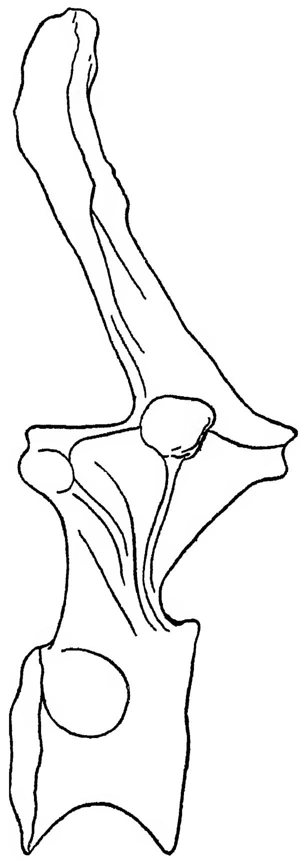


FIGURE 2.—Outline of tenth dorsal vertebra, U.S.N.M. No. 10865, to show forward inclination of the spinous process. About one-sixth natural size

Mention should also be made of the extreme closeness of the articulations of the vertebral centra, indicating a very thin disk of cartilage between their ends. The evidence afforded by this articulated series, and it applies equally well to the caudal vertebrae, refutes the more or less prevalent idea that in articulating dinosaur skeletons the vertebrae should be perceptibly drawn apart to allow for a thick disk of intercentral cartilage.

On account of the vicissitudes of fossilization the transverse processes of the right side of the dorsal vertebrae have been crushed upward somewhat above their natural position, so that with the ribs articulated the contour of the thorax of the two sides presents slightly different outlines.

The principal dimensions of the dorsal vertebrae are given in Table 1.

TABLE 1.—*Comparative measurements of dorsal vertebrae of* Diplodocus

Vertebra No.	Greatest length of centrum		Greatest transverse diameter of centra, posterior end		Greatest height of vertebrae	
	U.S.N.M. No. 10865	C. M. No. 84	U.S N.M. No. 10865	C. M. No. 84	U.S.N.M. No. 10865	C. M. No. 84
	Mm	*Mm*	*Mm*	*Mm*	*Mm*	*Mm*
1	460	510	270	255	650	614
2	376	416	250	233	740	691
3	340	328	270	311	775	722
4	275	318	283	343	750	718
5	253	255	283	300	765	781
6	260	255	270	280	800	793
7	280	264	275	280	835	810
8	243	275	280	309	874	847
9	230	290	295	288	900	946
10	200	267	340	313	936	966

Sacral vertebrae.—The complete sacrum is present with both ilia in position. It consists of five ankylosed vertebrae, all of which are coossified with and give support to the ilia. The conditions found to obtain in the sacral region are very similar to those described by Hatcher[17] in *Diplodocus carnegii*, differing only in minor details. The neural spines of the three middle sacrals have coalesced into a single spine, which in this individual is especially massive, being subequally expanded transversely and anteroposteriorly. The presence of three separate bony ossicles interposed between the tops of the spines is unique, as but a single one has previously been found. The most anterior of these ossicles lies between dorsal 10 and sacral 1; the second between sacrals 1 and 2, and the third between sacrals 4 and 5.

These ossicles are massive, subtriangular in shape, and conform nicely to the interspace between the spines. Their rugose surfaces indicate their inclusion in cartilage, as there is no indication of actual contact of the bone surfaces. It seems quite probable that similar ossicles were present between the spines of the three now coossified, but all trace of their union is obliterated, so that one can not be sure of the condition suggested.

Caudal vertebrae.—The caudal region has been fully described by previous authors, and at this time it appears only necessary to call attention to certain details displayed for the first time in *Diplodocus* by this particular individual.

In their general proportions, development of laminae, and progressive structural changes, the caudal vertebrae of this specimen agree very closely with the American Museum specimen of *Diplo-*

[17] Mem. Carnegie Mus., vol. 1, p. 30, 1901.

docus longus as described by Osborn.[18] The vertebrae steadily increase in length from the first to the eighteenth and then diminish to the last of the series; the median cleft on the summit of the spines disappears posterior to caudal 8, the diapophyses reduce in size posteriorly, and the lateral cavities extend as far back as the nineteenth vertebra.

An interesting feature of this tail is the complete coossification of the seventeenth, eighteenth, nineteenth, and twentieth vertebrae into a solid rigid section (see fig. 3); and in front of this section caudals 15 and 16 are similarly but less fully united. Coossification of the caudal vertebrae in *Diplodocus* has been previously noted by Hatcher[19] in specimen No. 94 of the Carnegie Museum, where the seventeenth and eighteenth are coossified, and again in Carnegie Museum specimen No. 84, of caudals 2 and 3. Holland[20] in a later communication points out that more careful study indicates that the coossified vertebrae designated the seventeenth and eighteenth by Hatcher in specimen No. 94 are Nos. 20 and 21 of the series, and he adds the information that Nos. 24 and 25 of this same specimen are also coossified.

The coossification of these tail vertebrae in *Diplodocus* has been directly attributed to traumatic causes, but in the National

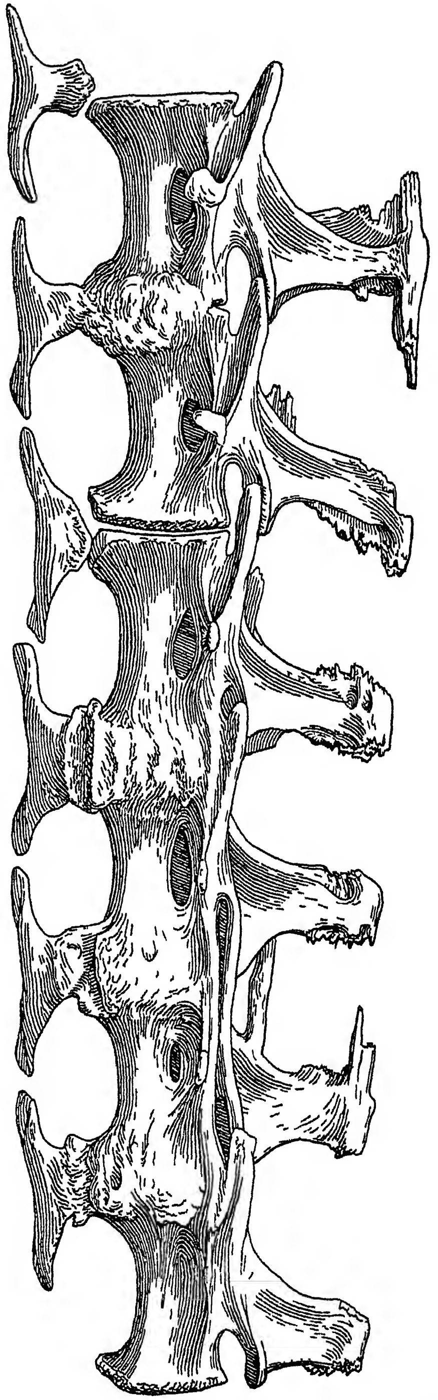


FIGURE 3.—Coossified caudal vertebrae (fifteenth to the twentieth) of *Diplodocus longus*. About one-eleventh natural size.

[18] Mem. Amer. Mus. Nat. Hist., vol. 1, pp. 204–209, 1899.

[19] Mem. Carnegie Mus., vol. 1, no. 1, p. 36, 1901.

[20] Amer. Nat., vol. 44, p. 255, 1910.

Museum specimen there are reasons for believing they may be due to senility. In the first place there is no distortion of the bones, and while there is a small excess of extraneous bony matter extending over the joints, it is in no way comparable to the lesion on sauropod caudals described and illustrated by Moodie.[21]

Secondly, the ligaments connecting the spines have also ossified to some extent in this solid section as well as in front of it, as is clearly shown in Figure 3. Between the spines of Nos. 18 and 19 at their bases a completely ossified ligamentary bar joins the two, as shown in Figure 3.

Why coossification of the vertebra should take place in this particular section of the tail is difficult of explanation. Hatcher explained it as being the point where the tail first touched the ground and for that reason was more susceptible to injury. With the dorsal elevation of the tail, it no longer touches the ground in this region but posterior to it, and thus this explanation no longer obtains.

The tail as reconstructed in the present skeleton consists of 31 original caudal vertebrae, 29 of which form a continuous series with the sacrals. The other two vertebrae were found disarticulated, but not far removed from the end of the above-mentioned series. These are thought to represent the thirty-third and thirty-fifth, respectively. The missing vertebrae, including the long whiplike extremity, have been replaced by casts made from the composite tail of the *Diplodocus* skeleton in the Carnegie Museum.

In introducing these casts considerable disparity in size between caudals of the same serial position in the two specimens was found, and we were obliged to omit four vertebrae from the Pittsburgh series on account of their larger size. In other words, the thirtieth as used in the present skeleton is the thirty-fourth of the Carnegie Museum specimen. This omission shortens the tail by 3 feet, as contrasted with the Pittsburgh caudal series.

A distal caudal centrum (Qu. No. 82) with some of the neural arch found with the other scattered caudals at the end of the articulated series could not be used because of its reduced length, being considerably shorter than any of the casts of this section of the tail. Whether this abbreviated caudal indicates a shorter tail in this individual, or whether it does not pertain to the present specimen, is a question that can not be determined until a complete articulated caudal series of *Diplodocus* is discovered in the Dinosaur National Monument area. At this time it seems best to omit it and complete the whiplike portion with the casts of the Pittsburgh specimen which formed an articulated[22] series.

[21] Amer. Journ. Sci., vol. 41, pp. 530–531, fig. 1, 1916.
[22] Holland, W. J., Mem. Carnegie Mus., vol. 2, no. 6, p. 253, 1906.

TABLE 2.—*Comparative measurements of caudal vertebrae of* Diplodocus

Vertebra No.	Greatest length of centrum			Greatest diameter of centrum, posterior end		Greatest height of vertebra, above middle of inferior border	
	U.S.N.M. No. 10865	C. M. No. 84	A. M. N. H. No. 223	U. S. N. M. No. 10865	C. M. No. 84	U.S.N.M. No. 10865	C. M. No. 84
	Mm	*Mm*	*Mm*	*Mm*	*Mm*	*Mm*	*Mm*
1	160	183	152	354	334	917	1,049
2	190	------	163	360	------	827	995
3	210	------	182	332	332	800	897
4	230	250	193	312	330	761	830
5	240	250	205	299	325	702	777
6	240	237	210	327	309	680	744
7	245	237	216	327	317	665	690
8	240	246	215	325	309	586	675
9	240	270	214	318	300	570	651
10	250	269	241	302	295	555	610
11	260	269	267	288	285	530	610
12	280	295	277	265	272	523	576
13	290	------	270	260	------	507	------
14	300	------	305	252	------	480	------
15	305	------	290	248	------	435	------
16	310	------	318	228	------	427	------
17	320	------	300	------	------	400	------
18	325	------	320	------	------	397	------
19	310	------	310	------	------	378	------
20	305	------	300	186	------	340	------
21	298	------	297	171	------	302	------
22	288	------	296	164	------	269	------
23	280	------	285	147	------	------	------
24	272	------	272	143	------	229	------
25	265	------	255	132	------	225	------
26	253	------	242	124	------	188	------
27	235	------	225	112	------	178	------
28	223	------	212	93	------	175	------
29	205	------	201	88	------	167	------
30	------	------	------	------	------	------	------
31	------	------	------	------	------	------	------
32	------	------	------	------	------	------	------
33	163	------	------	74	------	160	------
34	------	------	------	------	------	------	------
35	155	------	------	68	------	128	------

Chevrons.—The total number of chevron bones in *Diplodocus* is unknown at this time. In the specimen described by Osborn[23] there were 26, and this number has been followed in later restorations of the tail. I am inclined to the opinion that a still greater number will eventually be found. In the present specimen 18 chevron bones are represented wholly or in part. Six of these were found articulated, one between caudals 4 and 5, and the remaining 5 from near the middle of the tail were coossified with their respective vertebrae.

For the sake of clearness the chevrons are enumerated with the vertebrae; that is, the first chevron which occurs between the

[23] Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 5, p. 200, 1899.

second and third caudals is designated the third. Thus numbered, the fourth, sixteenth, eighteenth, nineteenth, twentieth, and twenty-first were found articulated. From these fixed points the other more or less scattered elements have been allocated.

A large chevron bone found near the proximal caudals was at first thought to belong to the present specimen, but its very large size with an open haemal canal was not in accord with the known chevron of this region in *Diplodocus*, and it therefore has been omitted from the skeleton.

The twelfth chevron, arbitrarily placed in the series, is unlike any known chevron of *Diplodocus* either in shape or position in the series, but its occurrence in relation to the tail and its general features both suggest relationship with the present specimen. This bone is open above the haemal arch, expanded at its base with an elongated extension that turns posteriorly nearly at right angles to the articular portion. In the specimen described by Osborn all chevrons are closed above the haemal canal as far posterior as the thirteenth chevron. With the few exceptions briefly discussed, all the other chevron bones are in accord with previously known specimens, which have been fully described by Osborn and Hatcher.

Ribs.—Of the 20 thoracic ribs that form the complete series in *Diplodocus*, 10 are preserved in the present specimen. The first is missing from the left side, but the other nine were found articulated with their respective vertebrae. The remaining rib, the third of the right side, was found disarticulated but not far removed from the vertebral column. The ninth and tenth ribs were fully coalesced with the diapophyses of the vertebrae and the eighth partially so, thus giving additional evidence of the senile character of the individual. Riggs [24] has observed a somewhat similar condition in *Apatosaurus* in that the last rib was fully ankylosed with the transverse process.

The ribs, except for the loss of minor portions, are in a splendid state of preservation, and having suffered but little distortion from post-mortem causes they display for the first time the true shape of the thorax.

The ribs as articulated differ from previous reconstructions in two important particulars—first, a decided backward sweep of the lower portion of the shafts of the third and fourth; and second, the strong inward curvature of the distal portion of the posterior members of the series. In both of these respects they are in striking contrast to the more or less straight ribs in the *Diplodocus carnegii* skeleton in Pittsburgh. Critical examination of the plaster ribs

[24] Field Columbian Mus. Publ. 82, vol. 2, p. 177, 1903.

cast from the above-mentioned specimen, which were used to replace those missing, seems to show that the originals had been somewhat straightened, probably to conform to some preconceived notion. This backward curvature of the heavier ribs is not a feature new to sauropodous dinosaurs, as evidenced by mounted skeletons of *Apatosaurus* (*Brontosaurus*) in the Field Museum of Natural History, Chicago, and the American Museum of Natural History, New York. It therefore should occasion no especial comment that a somewhat similar condition is now found to exist in *Diplodocus*.

The body proper is short and deep as indicated by the ribs, some of which are more than 5 feet in length. The five posterior ribs, however, all of which are completely preserved, have a decided inward curvature beginning a foot or more above their distal ends. This inward deflection outlines the body as passing smoothly inward to form the flank, which in turn coincides with the form of the lower pelvic bones.

As mentioned previously the tenth rib was fully coalesced with the diapophyses, and it shows this rib as bending forward from the transverse process far enough to clear fully the anterior end of the ilium. In the Pittsburgh and American Museum specimens as articulated it extends downward inside the blade of the ilium. From the evidence of the present specimen it would seem that the position of this rib varies with the individual.

The position of the scapula along the anterior ribs seems to be indicated by a flattening of their upper halves on the outside, which could be of no other use than that mentioned.

Measured over the curve, the complete ribs of this specimen have the lengths given in Table 3.

TABLE 3.—*Comparative measurements of ribs of* Diplodocus

Rib No.	U.S.N.M. No. 10865	C. M. No. 84	A. M. N. H. No. 223	Rib No.	U.S.N.M. No. 10865	C. M. No. 84	A. M. N. H. No. 223
	Mm	*Mm*	*Mm*		*Mm*	*Mm*	*Mm*
1		1,057		6	1,680	1,680	
2	[1] 1,205	1,300		7	1,515	1,580	
3		1,590		8	1,325	1,330	1,320
4		1,710		9	1,207	1,140	1,100
5	[1] 1,632	1,727		10	[1] 870	795	794

[1] Estimated.

Scapula.—There has been the greatest diversity of opinion among paleontologists as to the proper position of the scapula in the skeletons of sauropodous dinosaurs.

Scapulae have been articulated high up on the ribs, in an inclined position, nearly vertical, and low down in a horizontal pose. Per-

haps the most radical departure from previously held views is that of Osborn and Mook in a reconstruction of *Camarasaurus supremus* in which the shoulder blade is placed in a nearly vertical position that brought about a great elevation of the shoulders, making this the highest point in the vertebral column. The natural downward curve of the anterior dorsal vertebrae in the present skeleton renders this pose impossible in *Diplodocus*. There seems to be further objection on account of the fact that with the scapula in a nearly vertical pose the coalesced coracoid has its lowermost extremity thrown in so close to the front of the humerus as seriously to interfere with its movement, whereas a more horizontal position at once relieves this condition.

In the present skeleton the scapula has been posed in a more inclined position for the reason that the anterior ribs have flattened external surfaces that seem adapted to the purpose of providing a surface over which the elongated blade of the scapula could play. Furthermore, an articulated skeleton of *Camarasaurus lentus* [25] in the Carnegie Museum gives first-hand evidence that the scapula in sauropodous dinosaurs occupied a more horizontal position. In this connection it is of interest to note that Prof. R. S. Lull has reached the same conclusion as illustrated by the skeleton of *Camarasaurus lentus* and *Brontosaurus excelsus* recently mounted under his direction.[26]

TABLE 4.—*Comparative measurements of scapula and coracoid of* Diplodocus

Measurement	U.S.N.M. No. 10865	C.M. No. 84
	Mm	*Mm*
Combined length of scapula and coracoid	1,508	1,600
Greatest length of scapula	1,153	1,240
Greatest breadth of scapula	602	605
Least breadth of scapula	228	204
Length of coracoid	355	512
Greatest expanse of glenoid cavity	320	274

Pelvis.—The complete pelvic arch was recovered. The ilia were found attached to the sacrum, but the pubes and ischia, though each pair remains articulated, had been shifted to the eastward of the main part of the skeleton. These bones are in full accord with Hatcher's description of the pelvis of *Diplodocus* and call for no special comment here. Their principal dimensions are given in Table 5.

[25] Gilmore, C. W., Mem. Carnegie Mus., vol. 10, p. 376, pls. 14, 17, 1925.
[26] Amer. Journ. Sci., vol. 19, p. 3, fig. 1, 1930.

TABLE 5.—*Measurements of pelvic bones of* Diplodocus

Measurement	U.S.N.M. No. 10865	C. M. No. 84
	Mm	*Mm*
Greatest length of ilium	945	1,089
Greatest width of pelvis across the posterior end	920	----------
Greatest depth of ilium through greater peduncle	635	----------
Greatest width of acetabulum	380	----------
Greatest width of centrum of fifth sacral	384	----------
Greatest length of pubes	820	1,000
Greatest breadth of proximal end	410	400
Greatest length of ischium	870	940
Greatest breadth of proximal end	515	435

Fore limb.—The preservation of both humeri, the ulnae, and the right radius with this specimen makes these, so far as I can learn, the most complete fore limbs yet found in definite association with so complete a skeleton of *Diplodocus.* Furthermore, the right limb was found articulated at the elbow, and it gave proof of the correctness of Hatcher's observations [27] as to the proper articulation of these bones at this joint. Reference is especially made to the position of the proximal end of the ulna, which almost entirely incloses the radius and has its articular surface opposed to that of the humerus throughout its entire breadth. The radius articulates with the median anterior surface of the humerus only.

The most striking feature of the *Diplodocus* humerus is the strong angulation of the two ends in relation to each other. In other words, planes passed through their greatest diameters would bisect one another at an angle of 45°. When placed in position in the articulated limb this torque throws the deltoid crest far in under the main axis of the bone. The head is situated in about the middle of the proximal end and is not produced backward beyond the posterior border. At the distal end the ulnar and radial condyles are feebly developed in front and separated by a longitudinal groove. The anconeal fossa is moderate in depth.

The radius and ulna have been illustrated and described by Hatcher [28] so that it is needless to mention them further here.

The restriction of the articular surface of the two extremities of the humerus entirely to the ends and the almost total absence of an olecranon process on the ulna are both features indicating that the limb was not greatly flexed at the elbow in a standing position, a fact that is quite in keeping with the great weight to which they gave support. These features are in striking contrast to the robust olecranon and extensive articular surface of the humerus in such strongly flexed limbs as are found in *Stegosaurus* and *Triceratops.*

[27] Mem. Carnegie Mus., vol. 2, no. 1, pp. 72, 73, 1903.
[28] Loc. cit. pp. 72–73.

The principal measurements of the fore limb are as follows:

	Mm
Humerus, length	1,010
Humerus, least circumference	440
Ulna, length	740
Ulna, least circumference	295
Radius, length	690
Radius, least circumference	244

The missing fore feet have been replaced by casts furnished by the Carnegie Museum, whose composition is based, according to Hatcher, upon specimens and descriptions kindly furnished by Dr. H. F. Osborn, of the American Museum of Natural History.

Positive determination of their correctness is still wanting, for these elements are missing in the five more or less complete skeletons of *Diplodocus* now known. The feet as they came to us were provided with three terminal phalanges, but in the present mount all but the first have been omitted for the reason that on the many articulated fore feet now known of sauropodous dinosaurs never has more than one clawlike ungual been found and that on Digit I. It therefore seems reasonable to suppose that *Diplodocus* had a similarly constructed manus. In fact, in a foot attributed to *Diplodocus* described by Osborn [29] mention is made of a single terminal phalanx only.

Hind limb.—The right hind limb, including the tarsus and pes, was found complete and articulated. The femur when compared with that of *D. carnegii* (C. M. No. 84) is relatively slenderer, and the two ends are much less expanded, as is clearly indicated in the table of comparative measurements. Otherwise the two bones are in accord. Although the present femur is slightly longer than either of those of the Carnegie Museum specimen, the tibia is slightly shorter. However, these differences in length are so slight as to be readily accounted for by individual variation, or perhaps they are due to elongation through pressure from the weight of superimposed strata. The tibia and fibulae are of the elongated type typical of the relatively slender-limbed *Diplodocus.*

The osseous portion of the tarsus consists of the astragulus only. The pes is complete and displays the digital formula 2, 3, 3, 2, 2. Digits I, II, and III are terminated by clawlike unguals that progressively decrease in size toward the outer side of the foot. The ungual of Digit I has much of the tip missing, probably on account of an injury during life, since the end is rounded and healed. The presence of a small clawed ungual on the third toe fully confirms Hatcher's surmise that such a bone existed, although it was missing from the specimen studied by him.

[29] Bull Amer Mus Nat. Hist, vol. 14, p 205, 1901

There was no evidence of a third phalanx on Digit III, although the *D. carnegii* pes shows four. There was a single atrophied phalanx on Digit V. The absence of this bone in the foot of *D. carnegii* suggests that it may have entirely disappeared in some individuals of *Diplodocus*, although present in *Brontosaurus*. Metatarsal V is much stouter and has a wider and more robust proximal end than the corresponding element of the *D. carnegii* pes, but the proportions of the other bones are remarkably similar.

TABLE 6.—*Comparative measurements of hind limbs of* Diplodocus

Measurement	U.S.N.M. No. 10865	C. M. No. 84	C. M. No. 94
FEMUR:	*Mm*	*Mm*	*Mm*
Greatest length	1,600	1,542	1,470
Breadth, proximal end	349	500	390
Breadth, distal end	298	412	365
TIBIA:			
Greatest length	960	-----------	1,006
Breadth, proximal end	363	-----------	274
Breadth, distal end	240	-----------	195
FIBULA:			
Greatest length	1,055	-----------	1,050
Breadth, proximal end	216	-----------	213
Breadth, distal end	175	-----------	155

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